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Term: l11 and (channel)

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USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l9 and (ellipse or elliptical or elliptically)	19	L10
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USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and (Helmholtz)	25	L7
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USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l4 and (Helmholtz)	4	L5
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and (ellipse or elliptical or elliptically)	32	L4
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l2 and (transverse with coil)	178	L3
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l1 and (longitudinal with coil)	759	L2
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	((magnetic adj resonance) or MRI or NMR)	119090	L1

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☐ 1. Document ID: US 6194900 B1

L12: Entry 1 of 3 File: USPT Feb 27, 2001

US-PAT-NO: 6194900
DOCUMENT-IDENTIFIER: US 6194900 B1

TITLE: Integrated miniaturized device for processing and NMR detection of liquid phase samples

DATE-ISSUED: February 27, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Freeman; Dominique M.	Pescadero	CA	N/A	N/A
Swedberg; Sally A.	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 324/321; 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

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☐ 2. Document ID: US 5664568 A

L12: Entry 2 of 3 File: USPT Sep 9, 1997

US-PAT-NO: 5664568
DOCUMENT-IDENTIFIER: US 5664568 A

TITLE: Split-top, neck and head vascular array for magnetic resonance imaging

DATE-ISSUED: September 9, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Srinivasan; Ravi	Richmond Hts.	OH	N/A	N/A
Henderson; Robert G.	Wickliffe	OH	N/A	N/A
Elek; Robert A.	Chardon	OH	N/A	N/A

US-CL-CURRENT: 600/422; 324/318, 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

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☐ 3. Document ID: US 5543711 A

L12: Entry 3 of 3 File: USPT Aug 6, 1996

US-PAT-NO: 5543711
DOCUMENT-IDENTIFIER: US [illegible]3711 A

TITLE: Multiple quadrature volume coils for magnetic resonance imaging

DATE-ISSUED: August 6, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Srinivasan; Ravi	Richmond Hts.	OH	N/A	N/A
Elek; Robert A.	Chardon	OH	N/A	N/A
Liu; Haiying	Euclid	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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Term	Documents
CHANNEL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	924163
CHANNELS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	446283
(11 AND CHANNEL).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	3

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L12: Entry 2 of 3 File: USPT Sep 9, 1997

DOCUMENT-IDENTIFIER: US 5664568 A
TITLE: Split-top, neck and head vascular array for magnetic resonance imaging

BSPR:
The present invention relates to the magnetic resonance arts. It finds particular application in conjunction with split-top insertable radio frequency coils for magnetic resonance imaging of the head and neck and will be described with particular reference thereto. It is to be appreciated, however, that the present invention will also find application in other multiple coil techniques, spectroscopy, phased array coils, imaging for other than medical diagnostic purposes, and the like.

BSPR:
Conventionally, magnetic resonance imaging systems generate a strong, uniform static magnetic field B.sub.0 in a free space or bore of a magnet. This main magnetic field polarizes the nuclear spin system of an object in the bore to be imaged. The polarized object then possess a macroscopic magnetic moment vector pointing in the direction of the main magnetic field. In a superconducting main magnet assembly, annular magnets generate the static magnetic field B.sub.0, along a longitudinal or z-axis of the cylindrical bore.

BSPR:
To generate a magnetic resonance signal, the polarized spin system is excited by applying a radio frequency field B.sub.1, perpendicular to the z-axis. Typically, a radio frequency coil for generating the radio frequency field is mounted inside the bore surrounding the sample or patient. In a transmission mode, the radio frequency coil is pulsed to tip the magnetization of the polarized sample away from the z-axis. As the magnetization precesses around the z-axis back toward alignment, the precessing magnetic moment generates a magnetic resonance signal which is received by the radio frequency coil in a reception mode.

BSPR:
Birdcage coils, like other magnetic field coils, undergo mutual inductive coupling when positioned adjacent each other. As the coils approach each other, the mutual inductive coupling tends to increase until a "critical overlap" is reached. At the critical overlap, the mutual inductance drops to a minimum. As the coils are moved towards a complete coincidence from the critical overlap, the mutual inductive coupling again increases. See, "Optimized Birdcage Resonators For Simultaneous MRI of the Head and Neck", Leussler, SMRM, 12th Annual Meeting, Book of Abstracts, page 1349(1993).

BSPR:
"Novel Two Channel Volume Array Design For Angiography of the Head and Neck", Reykowski, et al., SMR 2nd Annual Meeting, Book of Abstracts, pp. 216 (1994), discloses a birdcage coil in combination with two volumetric Helmholtz coils arranged such that the B.sub.1 fields of the two Helmholtz coils are diagonal and perpendicular to one another. The two quadrature combined outputs, one from the birdcage coil and one from the Helmholtz coils are interfaced to two channels of the system. By orienting the two Helmholtz coils such that their B.sub.1 fields are orthogonal, coupling is reduced and the noise correlation therebetween held to a minimum. However, when these two volume coils are overlapped with a quadrature head coil, they experience the same difficulties discussed above in conjunction with the multiple birdcage coils. That is, when different sampled geometries are introduced, the isolation between the individual volume Helmholtz coils and the head coil change, causing a change in isolation, resulting in an increased noise correlation between all coils and a lower combined signal-to-noise ratio. Manufacturability of the coil is again complex and time-consuming.

BSPR:
"Head and Neck Vascular Array Coil For MRI", Srinivasan, et al., SMR 2nd Annual Meeting, Book of Abstracts, pp. 1107(1994) and the applicants' co-pending earlier filed related U.S. patent application Ser. No. 08/343,635, filed Nov. 22, 1994

disclose a combination birdcage coil and quadrature volume coil pair. In the described coil design, the coils maintained different current distributions with preferred mode orientations independent of one another. The coil consists of a birdcage coil and a quadrature volume coil pair. The quadrature volume coil pair consists of at least two surface coils of the distributed type, that maintain preferred mode orientations with respect to one another at all times. The birdcage coil maintains an eight-fold symmetry; whereas, the surface coil maintains a two-fold symmetry. After a nominal overlap is achieved between the coils of this design, only one iteration of tuning is required to retune all coils to the magnetic resonance frequency.

BSPR:
In accordance with one aspect of the present invention, a magnetic resonance apparatus is provided. A magnet generates a temporally constant, uniform magnetic field through an examination region. At least one radio frequency coil performs at least one of transmitting radio frequency signals into the examination region to induce and manipulate resonance of dipoles therein and receives radio frequency signals from the resonating dipoles. A processor processes the received magnetic resonance signals. The radio frequency coil is characterized by including a first volume coil assembly and a second volume coil assembly. The second volume coil assembly is disposed contiguous to and partially overlapping the first volume coil assembly in a common overlap region. A first electrical circuit is mounted adjacent to and connected with the second volume coil assembly. A first coaxial lead extends from the first electronic circuitry past and contiguous to the first volume coil assembly to a region on the opposite side of the first volume coil assembly from the second volume coil assembly. A first coil-to-coil decoupling circuit is connected with the first coaxial cable for inhibiting the first and second volume coil assemblies from communicating along the first coaxial cable.

BSPR:
In accordance with another aspect of the present invention, a method of magnetic resonance imaging is provided. A temporally constant uniform magnetic field is generated through a head and neck examination region. Magnetic field gradients are applied across the examination region. Radio frequency signals are transmitted into the examination region to induce and manipulate magnetic resonance of dipoles therein. Radio frequency signals are received from the resonating dipoles with a radio frequency coil assembly that has a first volume coil around the head region and a second volume coil around the neck region. The received radio frequency signals are processed into an image representation. The method is further characterized by the magnetic resonance signals from the resonating dipoles in the patient's head and neck regions being received concurrently with the first and second volume coils to generate a volumetric image representation of the head and neck region.

DRPR:
FIG. 1 is a diagrammatic illustration of a magnetic resonance imaging system with an insertable head and neck coil in accordance with the present invention;

DEPR:
An insertable radio frequency coil 40 is removably mounted in the bore in an examination region defined around an isocenter of the magnet 10. In the embodiment of FIG. 1, the insertable radio frequency coil is a head and neck coil for imaging one or both of patient's head and neck.

DEPR:
An operator interface and control station includes a human-readable display, such as a video monitor 52, and an operator input means including a keyboard 54, a mouse 56, a trackball, light pen, or the like. A computer control and reconstruction module 58 includes hardware and software for enabling the operator to select among a plurality of preprogrammed magnetic resonance sequences that are stored in a sequence control memory. A sequence controller 60 controls gradient amplifiers 62 connected with the gradient coil assembly 30 for causing the generation of the G.sub.x, G.sub.y, and G.sub.z gradient magnetic fields at appropriate times during the selected gradient sequence and a digital transmitter 64 which causes a selected one of the whole body and insertable radio frequency coils to generate B.sub.1 radio frequency field pulses at times appropriate to the selected sequence.

DEPR:
With continuing reference to FIG. 1 and further reference to FIGS. 2 and 3, the preferred insertable radio frequency coil 40 includes a birdcage coil 42 and a quadrature coil pair 44 including an upper or anterior coil 44a and a lower or posterior coil 44b. The patient's head is received within the birdcage coil with the anterior coil 44a wrapping around the patient's upper shoulder onto the patient's chest and the posterior coil 44b wrapping around the lower side of the patient's shoulders and along the patient's back. Each of the coils has outputs for two linear

modes, preferably orthogonal modes. The birdcage coil and the coils in the quadrature coil pair have capacitors or inductive elements added at appropriate locations such that each operates in a low pass, high pass, band pass, or band stop configuration.

DEPR:
In the preferred split-top embodiment, an upper half of the birdcage coil and the anterior coil are housed in a first or removable housing portion 80. To reduce claustrophobic effects on the patient, the upper housing portion has windows 82 between adjacent legs of the birdcage coil. The upper housing portion is removably received on a lower housing portion 84 which rests on the patient support. The upper and lower housing portions are interconnected by mechanical pins or connectors (not shown). Electrical connectors 86, such as pin, contacts, capacitive couplings, or the like, which may be the same as the mechanical pin or connector assemblies, electrically interconnect end rings 88a, 88b of the birdcage coil 42. Preferably, a mechanical latch 90 holds the first and second portions of the insertable coil assembly together. Adapter tabs or other interconnectors (not shown) are associated with the insertable coil and the patient support to assure accurate alignment of the head coil assembly with the magnetic resonance system. An electrical plug or socket 92 is disposed adjacent a rear end of the insertable coil for interconnection with a matching socket or plug arrangement in the patient support. This enables built-in cable handling assemblies to be provided below the patient support to facilitate operation and use. Although not shown, it is understood that pads are also provided within the coil to immobilize the patient during scanning and to help with patient comfort.

DEPR:
With particular reference to FIGS. 3, 4, 4A and 4B, the head portion of the coil is of a birdcage design. The anterior neck coil 44a is etched on a flexible PC board 94a and mounted on its respective coil former. The coil former and PC board are fastened into the upper housing 80 after the appropriate overlap has been set. The PC board also carries an electronic assembly 96a including matching and decoupling electronics, a preamplifier protection circuit, a preamplifier, and a coaxial cable support assembly. The anterior neck coil is tuned and matched to the magnetic resonance frequency prior to overlapping with the birdcage coil 42. A 50 Ohm coaxial cable 98a passes through an S-shaped or extension region 100a, rides on a support bridge 102a that originates on the anterior neck side and extends along a central plane of the birdcage head coil, and connects to a decoupling circuit 104a. The decoupling circuit is located beyond or rearward of a guard ring 106 of the birdcage coil. The shield of the coaxial cable past the anterior decoupling circuit 104a is connected to the guard ring. As illustrated in FIG. 5, the anterior coaxial cable navigates over the guard ring to the bottom of the coil assembly to an interconnect or output board 108 and the plug or socket

DEPR:
With reference to FIG. 7, the neck and birdcage coils are each tuned 110, 112 and the orientation of their B.sub.1 fields is adjusted 114, 116. The tuned coils are overlapped 118 a selected amount, e.g., to a point of minimum mutual inductance. The S-shaped extension region 100a, 100b of the cables facilitate ready positioning of circuit boards 94a, 94b relative to the birdcage coil. Once overlapped to the selected point, the coils are fixed together 120. The birdcage coil and the neck coils are retuned 122, 124 in a single iteration to the magnetic resonance frequency. In most cases, the birdcage coil needs most of the retuning and the neck coil little or none. The extent of the retuning depends mainly on the proximity of the coaxial cables 98a and 98b to the birdcage coil 42. In most cases, the neck coil frequencies remain the same. Because only one iteration is needed to retune all coils to the same magnetic resonance frequency after achieving the selected overlap, the number of steps needed for optimization during manufacturing is reduced.

DEPR:
With reference to FIGS. 8A, 8B, and 8C, the anterior and posterior decoupling circuits 104a and 104b each include a housing having a top cover 130a and a bottom cover 130b within which a circular spool 132 is supported. The coaxial cable extends through a first immobilizer or guide 134a, around the spool, and exits by a second immobilizer or guide 134b. Fixed and variable capacitors are soldered across the turn(s) of the coaxial cable to tune the decoupling circuits close to the magnetic resonance frequency. When the top and bottom covers are closed, the immobilizers grip the coaxial cable sufficiently tightly that it is locked against sliding into or out of the housing. The immobilizers not only reduce any torque from being transmitted to the electronics within the decoupling circuit, but also protect against changes in inductance due to changes in the tightness of the winding around the spool. After the decoupling circuit housing is closed, a sheet of copper foil 136 is wrapped around the housing and the immobilizers. Once the decoupling circuit is positioned in place, the foil is pierced through a small hole 138 to gain access to a trimming capacitor and the decoupling circuit is tuned to the magnetic resonance frequency. After fine

tuning, the access opening to the trimming capacitor is foil covered as well. The foil covering functions as a radio frequency shield to isolate the decoupling tank circuit (FIG. 8C) for efficient decoupling circuit operation.

DEPR:
Tuning the decoupling circuits to the magnetic resonance frequency serves two major functions. The primary function is to present a high impedance (Z) for currents flowing in the shields of the coaxial cables during RF transmit. This prevents the formation of closed loops inside the magnet bore. The second function of each decoupling circuit is slightly different. The posterior neck coil has its second mode tuned to the magnetic resonance frequency. The posterior decoupling circuit isolates the currents flowing in the region where the shield of the coaxial cable is exposed to the birdcage coil from the currents flowing in the shield exposed to the posterior neck coil.

DEPR:
For the coaxial cable 98a above the anterior neck coil 44a, the central plane is a plane of symmetry. That is, the central plane is a virtual ground. The anterior neck coil has its first, primary mode tuned to the magnetic resonance frequency. The anterior coaxial cable is transparent to the anterior neck coil. However, when the coaxial cable is guided across the birdcage coil 42, the cable is no longer at a virtual ground plane and currents are induced in its shield. These circulating currents are substantially attenuated by the anterior decoupling circuit 104a. Again, the anterior decoupling circuit is before the guard ring 106 of the birdcage coil. This stops induced RF currents on the shield of the anterior coaxial cable from being communicated to the guard ring through the shorting connection. The guard ring is also broken by shorting capacitors (not shown) to reduce gradient induced eddy currents. The decoupling circuits are shielded to minimize their interaction with the body coil 36 during RF transmit, with the individual coils in the insertable coil 40, and to reduce any irradiation segments of shields of the straight segments of the coaxial cable.

DEPR:
Additional decoupling circuits may also be employed to provide further barriers to the transmission of stray radio frequency signals. If the decoupling circuits are eliminated completely, the coaxial cables would carry currents in their shields. Further, the interaction between the coils in the array would not be minimized. Rather, the two coils would talk to each other through the shield, causing a disadvantageous transfer of noise between the coils. The presence of the decoupling circuits as illustrated maintains the signal-to-noise ratio of the coils in its different operating modes within a few percent. The signal-to-noise ratio and uniformity of the illustrated insertable coil is similar to that of a standard quadrature head coil without neck coils. The signal-to-noise ratio of the posterior neck coil is similar to that of a C-spine element in a cervical-thoracic-lumbar array coil. However, the coverage of the neck coils is greater in the present design.

DEPR:
The coils 42, 44 are actively decoupled during body transmit. The coil is interfaced to the magnetic resonance system via an interface, such as the interface shown in U.S. application Ser. No. 08/286,780, filed Aug. 5, 1994. Individual channel device drivers in the system transmit/receive interface circuit are programmed to provide different sets of voltages in the three operating modes for the insertable radio frequency coil 40, viz, the head only, neck only, and head and neck mode. In the head mode, the neck coils are actively decoupled and only the head coil is resonant at the magnetic resonance frequency. Similarly, in the neck mode, the head coil is actively decoupled and only the neck coils are resonant at the magnetic resonance frequency. In the head and neck mode, all coils in the insertable radio frequency coil 40 are resonant at the larmor frequency and receive magnetic resonance signals.

DEPR:
The electrical circuits 96a, 96b of the preferred embodiment include a preamplifier and output for the anterior neck coil and a preamplifier and output for the posterior neck coil. A birdcage coil output circuit 96c includes two preamplifiers connected to the birdcage coil to provide 90.degree., quadrature outputs. These four preamplified signals in the illustrated embodiment are conveyed to the radio frequency receiver 66 which demodulates the four resonance signals. Alternately, the quadrature resonance signals can be shifted by 90.degree. and combined at the insertable coil rather than after demodulation. As yet another alternative, the signals can be digitized at the surface coil and digital signals sent to the receiver.

DEPR:
With reference to FIG. 10, a birdcage coil 150 with a pair of quadrature outputs provides uniform head coverage. Two loop type coils 152a, 152b provide anterior neck and arch coverage. Helmholtz and loop type coils 154a, 154b provide uniform posterior

neck coverage. The birdcage, the anterior neck coils, and the posterior neck coils may each be interfaced with one or two channels of the receiver to operate singly or in various combinations as discussed above. Other alternate embodiments include birdcage coils that have other than eight-fold symmetry and neck coils with other than two-fold symmetry. The birdcage coil may be circularly cylindrical, elliptically cylindrical, or have other geometries. The neck coil is contoured in such a way as to provide a high signal-to-noise ratio and uniform coverage over its imaging field of view. The coils in the volume quadrature pair can also be of the loop type, Helmholtz type, Figure-8 type, distributed type, or combinations thereof. The signals from the individual coils can be combined prior to or after quadrature combination or prior to or after preamplification. The signals may also be combined digitally post-data acquisition. As another alternative, the individual coils may be tuned to one or more selected magnetic resonance frequencies. In yet another alternate embodiment, the birdcage volume coil is combined with several quadrature pairs in a cascade manner to cover an elongated anatomy under investigation. Decoupling circuits of other designs for inhibiting the flow of radio frequency currents and different numbers of decoupling circuits may also be utilized. The insertable coil need not be in a split mechanical package. For example, the coil may be slid over the patient's head and neck or other portions of the patient's anatomy as may be appropriate to the coil design and application.

CLPR:
1. In a magnetic resonance apparatus which includes a magnet for generating a temporally constant, uniform magnetic field through an examination region, a radio frequency coil which performs at least one of (1) transmitting radio frequency signals into the examination region to induce and manipulate resonance of dipoles disposed therein and (2) receiving radio frequency signals from resonating dipoles in the examination region, and a processor for processing the received magnetic resonance signals, the radio frequency coil including:

CLPR:
2. In the magnetic resonance apparatus as set forth in claim 1, the second coil assembly including a first coil connected with the first coaxial cable and a second coil, the radio frequency coil further including:

CLPR:
3. In the magnetic resonance apparatus as set forth in claim 2, the second coil-to-coil decoupling circuit is disposed in a common plane with the overlap region.

CLPR:
4. In a magnetic resonance apparatus which includes a magnet for generating a temporally constant, uniform magnetic field through an examination region, at least one radio frequency coil which performs at least one of (1) transmitting radio frequency signals into the examination region to induce and manipulate resonance of dipoles disposed therein and (2) receiving radio frequency signals from resonating poles in the examination region, and a processor for processing the received magnetic resonance signals, the radio frequency coil including

CLPR:
5. In the magnetic resonance apparatus as set forth in claim 2, the second coil-to-coil decoupling electronic circuit being disposed substantially in a common plane with the overlap region.

CLPR:
6. In a magnetic resonance apparatus which includes a magnet for generating a temporally constant, uniform magnetic field through an examination region, a radio frequency coil which performs at least one of (1) transmitting radio frequency signals into the examination region to induce and manipulate resonance of dipoles disposed therein and (2) receiving radio frequency signals from resonating dipoles in the examination region, and a processor for processing the received magnetic resonance signals, the radio frequency coil including:

CLPR:
7. In a magnetic resonance apparatus which includes a magnet for generating a temporally constant, uniform magnetic field through an examination region, a radio frequency coil which performs at least one of (1) transmitting radio frequency signals into the examination region to induce and manipulate resonance of dipoles disposed therein and (2) receiving radio frequency signals from resonating dipoles in the examination region, and a processor for processing the received magnetic resonance signals, the radio frequency coil including:

CLPR:
8. In a magnetic resonance apparatus which includes a magnet for generating a

temporally constant, uniform magnetic field through an examination region, a radio frequency coil which performs at least one of (1) transmitting radio frequency signals into the examination region to induce and manipulate resonance of dipoles disposed therein and (2) receiving radio frequency signals from resonating dipoles in the examination region, and a processor for processing the received magnetic resonance signals, the radio frequency coil including:

CLPR:
9. A radio frequency coil for at least receiving magnetic resonance signals, the radio frequency coil comprising:

CLPR:
10. A radio frequency coil for at least receiving magnetic resonance signals, the radio frequency coil comprising:

CLPR:
11. A radio frequency coil for at least receiving magnetic resonance signals, the radio frequency coil comprising:

CLPR:
16. A radio frequency coil for receiving magnetic resonance signals, the radio frequency coil comprising:

CLPR:
17. In a method of magnetic resonance imaging in which a temporally constant uniform magnetic field is generated through a head and neck examination region, magnetic field gradients are applied across the examination region, radio frequency signals are transmitted into the examination region to induce and manipulate magnetic resonance of dipoles therein, radio frequency signals are received from the resonating dipoles with a radio frequency coil assembly that has a first coil assembly around the head region and a second coil assembly around the neck region, and the received radio frequency signals are processed into an image representation, the improvement comprising:

CLPR:
18. In the magnetic resonance imaging method as set forth in claim 17, the improvement further comprising:

CLPR:
19. In the magnetic resonance imaging method as set forth in claim 17, the improvement further comprising:

CLPR:
20. In the magnetic resonance imaging method as set forth in claim 17, the improvement further comprising:

CLPR:
21. In the magnetic resonance imaging method as set forth in claim 17, the improvement further comprising:

CLPR:
22. In a method of magnetic resonance imaging in which a temporally constant uniform magnetic field is generated through a head and neck examination region, magnetic field gradients are applied across the examination region, radio frequency signals are transmitted into the examination region to induce and manipulate magnetic resonance of dipoles therein, radio frequency signals are received from the resonating dipoles with a radio frequency coil assembly that has a first coil assembly around the head region and a second coil assembly around the neck region, at least one coaxial lead extends from the second coil assembly along the first coil assembly and has a radio frequency decoupling circuit of adjustable frequency therein, and the received radio frequency signals are processed into an image representation, the method comprising:

CLPR:
23. A magnetic resonance method comprising:

CLPR:
24. The magnetic resonance method as set forth in claim 23 further including:

CLPV:
a coil-to-coil decoupling circuit connected with the coaxial lead for inhibiting the first and second volume coil assemblies from coupling to each other along the coaxial cable while receiving the magnetic resonance signals such that cross-talk between the first and second volume coil assemblies is inhibited.

CLPV:
receiving magnetic resonance signals from resonating dipoles in at least one of the head and neck regions with corresponding first and second volume coil assemblies;

CLPV:
positioning a patient's head and neck in the first and second coil assemblies in preparation for inducing magnetic resonance.

CLPV:
adjusting the frequency of the decoupling circuit to match a received magnetic resonance frequency to prevent the first and second coil assemblies from coupling; and

CLPV:
receiving magnetic resonance signals from resonating dipoles in at least one of the head and neck regions with corresponding first and second coil assemblies to generate a volumetric image representation of at least one of the head and neck regions.

CLPV:
tuning a birdcage coil which is mounted on a dielectric former to a magnetic resonance frequency;

CLPV:
tuning neck coils that are mounted on dielectric formers to the magnetic resonance frequency;

CLPV:
exciting resonance of selected dipoles within the patient's head and neck such that the dipoles generate magnetic resonance signals;

CLPV:
receiving the magnetic resonance signals with at least one of the birdcage and neck coils.

ORPL:
"The NMR Phased Array", Roemer, et al., Academic Press, Inc. 1990 Magnetic Resonance in Medicine 16, 192-225 (1990).

ORPL:
"Optimized Birdcage Resonators for Simultaneous MRI of Head and Neck", Leussler, SMRM 1993, p. 1349.

ORPL:
"An Efficient, Highly Homogenous Radiofrequency Coil for Whole-Body NMR Imaging at 1.5 T", Hayes, et al., pp. 622-628.

ORPL:
"Head and Neck Vascular Array Coil For MRI", Srinivasan, et al., Society of Magnetic Resonance, 2nd Annual Meeting, San Francisco, CA (1994) p. 1107.

ORPL:
"Novel Two Channel Volume Array Design for Antiography of the Head and Neck", Reykowski, et al., SMR 2nd Annual Meeting, San Fransisco, CA (1994) p. 216.

ORPL:
"Quadrature-Headcoil and Helmholtz-Type Neckcoil--An Optimized RF Antenna-Pair For Imaging Head, Neck, and C-Spine at 1.0 and 1.5 T", Krause, et al. SMRM 7th Annual Meeting, San Francisco, CA (1988) p. 845.

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DIRECTIONS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	640754
(5 AND (OPPOSITE WITH DIRECTION)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	6

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USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and (single with coil)	30	L5
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and ("single adj coil")	0	L4
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l2 and ("single turn loop" or helix or "multiturn solenoid")	53	L3
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l1 and (coil with pair)	1840	L2
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	((magnetic adj resonance) or MRI or NMR)	119090	L1

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☐ 1. Document ID: US 6285189 B1

L5: Entry 1 of 30 File: USPT Sep 4, 2001

US-PAT-NO: 6285189
DOCUMENT-IDENTIFIER: US 6285189 B1

TITLE: Millipede coils

DATE-ISSUED: September 4, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wong; Wai Ha	San Jose	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/321, 335/299, 600/422

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

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☐ 2. Document ID: US 6232445 B1

L5: Entry 2 of 30 File: USPT May 15, 2001

US-PAT-NO: 6232445
DOCUMENT-IDENTIFIER: US 6232445 B1

TITLE: Soluble MHC complexes and methods of use thereof

DATE-ISSUED: May 15, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Rhode; Peter R.	Miami	FL	N/A	N/A
Acevedo; Jorge	Miami	FL	N/A	N/A
Burkhardt; Martin	Miami	FL	N/A	N/A
Jiao; Jin-an	Fort Lauderdale	FL	N/A	N/A
Wong; Hing C.	Fort Lauderdale	FL	N/A	N/A

US-CL-CURRENT: 530/387.3; 424/133.1, 424/185.1, 424/192.1, 424/193.1, 435/69.3, 530/350, 530/395

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

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☐ 3. Document ID: US 6087832 A

L5: Entry 3 of 30 File: USPT Jul 11, 2000

US-PAT-NO: 6087832
DOCUMENT-IDENTIFIER: US 6087832 A

TITLE: Edge-wound solenoids and strongly coupled ring resonators for NMR and MRI

DATE-ISSUED: July 11, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doty; F. David	Columbia	SC	N/A	N/A

US-CL-CURRENT: 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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4. Document ID: US 5764059 A

L5: Entry 4 of 30 File: USPT Jun 9, 1998

US-PAT-NO: 5764059
DOCUMENT-IDENTIFIER: US 5764059 A

TITLE: Acoustic screen

DATE-ISSUED: June 9, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Mansfield; Peter	Bramcote	N/A	N/A	GB2
Bowtell; Richard William	Nottingham	N/A	N/A	GB2
Chapman; Barry Leonard Walter	Stapleford	N/A	N/A	GB2
Glover; Paul Martin	Chilwell	N/A	N/A	GB2

US-CL-CURRENT: 324/318; 324/319

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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5. Document ID: US 5619140 A

L5: Entry 5 of 30 File: USPT Apr 8, 1997

US-PAT-NO: 5619140
DOCUMENT-IDENTIFIER: US 5619140 A

TITLE: Method of making nuclear magnetic resonance probe coil

DATE-ISSUED: April 8, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Brey; William W.	Sunnyvale	CA	N/A	N/A
Johansson; Marie E.	Palo Alto	CA	N/A	N/A
Withers; Richard S.	Sunnyvale	CA	N/A	N/A

US-CL-CURRENT: 324/318; 29/593

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

6. Document ID: US 5594342 A

L5: Entry 6 of 30 File: USPT Jan 14, 1997

US-PAT-NO: 5594342
DOCUMENT-IDENTIFIER: US 5594342 A

TITLE: Nuclear magnetic resonance probe coil with enhanced current-carrying capability

DATE-ISSUED: January 14, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Brey; William W.	Sunnyvale	CA	N/A	N/A
Withers; Richard S.	Sunnyvale	CA	N/A	N/A

US-CL-CURRENT: 324/322; 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

7. Document ID: US 5565778 A

L5: Entry 7 of 30 File: USPT Oct 15, 1996

US-PAT-NO: 5565778
DOCUMENT-IDENTIFIER: US 5565778 A

TITLE: Nuclear magnetic resonance probe coil

DATE-ISSUED: October 15, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Brey; William W.	Sunnyvale	CA	N/A	N/A
Anderson; Weston A.	Palo Alto	CA	N/A	N/A
Wong; Wai H.	Monterey Park	CA	N/A	N/A
Fuks; Luiz F.	Fremont	CA	N/A	N/A
Kotsubo; Vincent Y.	Sunnyvale	CA	N/A	N/A
Withers; Richard S.	Sunnyvale	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

8. Document ID: US 5564421 A

L5: Entry 8 of 30 File: USPT Oct 15, 1996

US-PAT-NO: 5564421
DOCUMENT-IDENTIFIER: US 5564421 A

TITLE: VHF applicator for magnetic resonance imaging

DATE-ISSUED: October 15, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Ehnholm; Gosta J.	Helsinki	N/A	N/A	FIX

US-CL-CURRENT: 600/410; 324/316, 324/318, 324/322, 333/219, 600/13

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 9. Document ID: US 5351688 A

L5: Entry 9 of 30 File: USPT Oct 4, 1994

US-PAT-NO: 5351688
DOCUMENT-IDENTIFIER: US 5351688 A

TITLE: NMR quadrature detection solenoidal coils

DATE-ISSUED: October 4, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Jones; Randall W.	Bellevue	NE	N/A	N/A

US-CL-CURRENT: 600/422; 324/318, 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 10. Document ID: US 5224922 A

L5: Entry 10 of 30 File: USPT Jul 6, 1993

US-PAT-NO: 5224922
DOCUMENT-IDENTIFIER: US 5224922 A

TITLE: Quasistatic biological cell and tissue modifier

DATE-ISSUED: July 6, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Kurtz; Warren H.	Lyndhurst	NJ	07071	N/A

US-CL-CURRENT: 600/13; 128/898, 600/14

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 11. Document ID: US 5201312 A

L5: Entry 11 of 30 File: USPT Apr 13, 1993

US-PAT-NO: 5201312
DOCUMENT-IDENTIFIER: US 5201312 A

TITLE: Antennae for high-resolution magnetic resonance imaging of the eye

DATE-ISSUED: April 13, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Schenck; John F.	Schenectady	NY	N/A	N/A
Souza; Steven P.	Williamstown	MA	N/A	N/A
Eisner; David R.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 600/422; 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 12. Document ID: US 5139024 A

L5: Entry 12 of 30   File: USPT   Aug 18, 1992

US-PAT-NO: 5139024
DOCUMENT-IDENTIFIER: US 5139024 A

TITLE: Resonators for magnetic resonance imaging

DATE-ISSUED: August 18, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bryant; Robert G.	Pittsford	NY	N/A	N/A
Hornak; Joseph P.	Scottsville	NY	N/A	N/A
Marshall; Eric A.	Rochester	NY	N/A	N/A

US-CL-CURRENT: 600/422; 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 13. Document ID: US 5024229 A

L5: Entry 13 of 30   File: USPT   Jun 18, 1991

US-PAT-NO: 5024229
DOCUMENT-IDENTIFIER: US 5024229 A

TITLE: Resonators for magnetic resonance imaging

DATE-ISSUED: June 18, 1991

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bryant; Robert G.	Pittsford	NY	N/A	N/A
Hornak; Joseph P.	Scottsville	NY	N/A	N/A
Marshall; Eric A.	Rochester	NY	N/A	N/A

US-CL-CURRENT: 600/422; 324/318, 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

14. Document ID: US 4969064 A

L5: Entry 14 of 30 File: USPT Nov 6, 1990

US-PAT-NO: 4969064
DOCUMENT-IDENTIFIER: US 4969064 A

TITLE: Apparatus with superconductors for producing intense magnetic fields

DATE-ISSUED: November 6, 1990

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Shadowitz; Albert	Wilmington	VT	05363	N/A

US-CL-CURRENT: 361/141; 335/216, 505/851

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

15. Document ID: US 4866387 A

L5: Entry 15 of 30 File: USPT Sep 12, 1989

US-PAT-NO: 4866387
DOCUMENT-IDENTIFIER: US 4866387 A

TITLE: NMR detector network

DATE-ISSUED: September 12, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hyde; James S.	Dousman	WI	N/A	N/A
Froncisz; Wojciech	Krakow	N/A	N/A	PLX
Jesmanowicz; Andrzej	Wauwatosa	WI	N/A	N/A
Kneeland; J. Bruce	Fox Point	WI	N/A	N/A

US-CL-CURRENT: 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

16. Document ID: US 4864192 A

L5: Entry 16 of 30 File: USPT Sep 5, 1989

US-PAT-NO: 4864192
DOCUMENT-IDENTIFIER: US 4864192 A

TITLE: CRT magnetic field compensation

DATE-ISSUED: September 5, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Buchwald; Randall H.	Waukesha	WI	N/A	N/A
Mrotek; Gary L.	Franklin	WI	N/A	N/A

US-CL-CURRENT: 315/8; 313/430, 315/370

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

17. Document ID: US 4841249 A

L5: Entry 17 of 30 File: USPT Jun 20, 1989

US-PAT-NO: 4841249
DOCUMENT-IDENTIFIER: US 4841249 A

TITLE: Truncated cone shaped surface resonator for nuclear magnetic resonance tomography

DATE-ISSUED: June 20, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Duerr; Wilhelm	Erlangen	N/A	N/A	DEX
Ingwersen; Hartwig	Uttenreuth	N/A	N/A	DEX
Krause; Norbert	Heroldsbach	N/A	N/A	DEX
Oppelt; Ralph	Uttenreuth	N/A	N/A	DEX

US-CL-CURRENT: 324/318; 324/322, 333/219

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

18. Document ID: US 4725779 A

L5: Entry 18 of 30 File: USPT Feb 16, 1988

US-PAT-NO: 4725779
DOCUMENT-IDENTIFIER: US 4725779 A

TITLE: NMR local coil with improved decoupling

DATE-ISSUED: February 16, 1988

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hyde; James S.	Dousman	WI	N/A	N/A
Froncisz; Wojciech	Krakow	N/A	N/A	PLX
Jesmanowicz; Andrzej	Wauwatosa	WI	N/A	N/A

US-CL-CURRENT: 324/318; 324/311, 333/219

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

19. Document ID: US 4721913 A

L5: Entry 19 of 30 File: USPT Jan 26, 1988

US-PAT-NO: 4721913
DOCUMENT-IDENTIFIER: US 4721913 A

TITLE: NMR local coil network

DATE-ISSUED: January 26, 1988

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hyde; James S.	Dousman	WI	N/A	N/A
Froncisz; Wojciech	Krakow	N/A	N/A	PLX
Jesmanowicz; Andrzej	Wauwatosa	WI	N/A	N/A
Grist; Thomas M.	Milwaukee	WI	N/A	N/A

US-CL-CURRENT: 324/318; 333/219, 600/422

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 20. Document ID: US 4621237 A

L5: Entry 20 of 30   File: USPT   Nov 4, 1986

US-PAT-NO: 4621237
DOCUMENT-IDENTIFIER: US 4621237 A

TITLE: Radiofrequency transducer and method of using same

DATE-ISSUED: November 4, 1986

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Timms; William E.	Eynsham	N/A	N/A	GBX

US-CL-CURRENT: 324/322; 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 21. Document ID: US 4607225 A

L5: Entry 21 of 30   File: USPT   Aug 19, 1986

US-PAT-NO: 4607225
DOCUMENT-IDENTIFIER: US 4607225 A

TITLE: Apparatus and method for reducing spurious currents in NMR imaging apparatus induced by pulsed gradient fields

DATE-ISSUED: August 19, 1986

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Crooks; Lawrence E.	Richmond	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/319

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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22. Document ID: US 4532474 A

L5: Entry 22 of 30 File: USPT Jul 30, 1985

US-PAT-NO: 4532474
DOCUMENT-IDENTIFIER: US 4532474 A

TITLE: Nuclear magnetic resonance imaging using pulse sequences combining selective excitation and driven free precession

DATE-ISSUED: July 30, 1985

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Edelstein; William A.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 324/309; 324/312

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw. Desc | Image

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23. Document ID: US 4521733 A

L5: Entry 23 of 30 File: USPT Jun 4, 1985

US-PAT-NO: 4521733
DOCUMENT-IDENTIFIER: US 4521733 A

TITLE: NMR Imaging of the transverse relaxation time using multiple spin echo sequences

DATE-ISSUED: June 4, 1985

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bottomley; Paul A.	Clifton Park	NY	N/A	N/A
Edelstein; William A.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 324/309; 324/307

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw. Desc | Image

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24. Document ID: US 4506223 A

L5: Entry 24 of 30 File: USPT Mar 19, 1985

US-PAT-NO: 4506223
DOCUMENT-IDENTIFIER: US 4506223 A

TITLE: Method for performing two-dimensional and three-dimensional chemical shift imaging

DATE-ISSUED: March 19, 1985

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bottomley; Paul A.	Clifton Park	NY	N/A	N/A
Edelstein; William A.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 324/309; 324/307

Full | Title | Citation | Front | Re | Classification | Date | Reference | KWIC | raw Desc | Image

☐ 25. Document ID: US 4484138 A

L5: Entry 25 of 30 File: USPT Nov 20, 1984

US-PAT-NO: 4484138
DOCUMENT-IDENTIFIER: US 4484138 A

TITLE: Method of eliminating effects of spurious free induction decay NMR signal caused by imperfect 180 degrees RF pulses

DATE-ISSUED: November 20, 1984

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bottomley; Paul A.	Clifton Park	NY	N/A	N/A
Edelstein; William A.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 324/307; 324/309

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

☐ 26. Document ID: US 4471306 A

L5: Entry 26 of 30 File: USPT Sep 11, 1984

US-PAT-NO: 4471306
DOCUMENT-IDENTIFIER: US 4471306 A

TITLE: Method of NMR imaging which overcomes T.sub.2 * effects in an inhomogeneous static magnetic field

DATE-ISSUED: September 11, 1984

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Edelstein; William A.	Schenectady	NY	N/A	N/A
Bottomley; Paul A.	Clifton Park	NY	N/A	N/A

US-CL-CURRENT: 324/309; 324/311

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

☐ 27. Document ID: US 4443760 A

L5: Entry 27 of 30 File: USPT Apr 17, 1984

US-PAT-NO: 4443760
DOCUMENT-IDENTIFIER: US 4443760 A

TITLE: Use of phase alternated RF pulses to eliminate effects of spurious free induction decay caused by imperfect 180 degree RF pulses in NMR imaging

DATE-ISSUED: April 17, 1984

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Edelstein; William A.	Schenectady	NY	N/A	N/A
Bottomley; Paul A.	Clifton Park	NY	N/A	N/A

US-CL-CURRENT: 324/309; 324/313, 324/314

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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28. Document ID: US 4442404 A

L5: Entry 28 of 30   File: USPT   Apr 10, 1984

US-PAT-NO: 4442404
DOCUMENT-IDENTIFIER: US 4442404 A

TITLE: Method and means for the noninvasive, local, in-vivo examination of endogeneous tissue, organs, bones, nerves and circulating blood on account of spin-echo techniques

DATE-ISSUED: April 10, 1984

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bergmann; Wilfried H.	D-5483 Bad Neuenahr	N/A	N/A	DEX

US-CL-CURRENT: 324/309; 324/315, 505/844

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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29. Document ID: US 4431968 A

L5: Entry 29 of 30   File: USPT   Feb 14, 1984

US-PAT-NO: 4431968
DOCUMENT-IDENTIFIER: US 4431968 A

TITLE: Method of three-dimensional NMR imaging using selective excitation

DATE-ISSUED: February 14, 1984

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Edelstein; William A.	Schenectady	NY	N/A	N/A
Bottomley; Paul A.	Clifton Park	NY	N/A	N/A

US-CL-CURRENT: 324/309; 324/311

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 30. Document ID: U[illegible]80769 A

L5: Entry 30 of 30 File: USPT Dec 25, 1979

US-PAT-NO: 4180769
DOCUMENT-IDENTIFIER: US 4180769 A

TITLE: Superconducting solenoid with compensation for axial gradients

DATE-ISSUED: December 25, 1979

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Gang; Robert E.	Sunnyvale	CA	N/A	N/A

US-CL-CURRENT: 324/319; 505/843, 505/844, 505/879

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 1. Document ID: US 5949311 A

L1: Entry 1 of 1 File: USPT Sep 7, 1999

US-PAT-NO: 5949311
DOCUMENT-IDENTIFIER: US 5949311 A

TITLE: Tunable resonators

DATE-ISSUED: September 7, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Weiss; Jerald A.	Wayland	MA	N/A	N/A
Temme; Donald H.	Concord	MA	N/A	N/A
Dionne; Gerald F.	Winchester	MA	N/A	N/A

US-CL-CURRENT: 333/202; 333/205, 333/219.1, 333/235

Full | Title | CIT.1 | REV.1 | CLS.1 | REF.1 | DRAW.1

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NMRS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	106
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L3: Entry 19 of 38 File: USPT Jan 11, 1994

DOCUMENT-IDENTIFIER: US 5278504 A
TITLE: Gradient coil with off center sweet spot for magnetic resonance imaging

BSPR:
The present invention relates to the art of magnetic field gradient generation. It finds particular application in conjunction with establishing gradient magnetic fields in magnetic resonance imaging techniques and will be described with particular reference thereto. It is to be appreciated, however, that the invention will also find application in spectroscopy and other processes and apparatus in which accurate and predictable magnetic field gradients are established or maintained.

BSPR:
In magnetic resonance imaging, a uniform magnetic field is created through an examination region in which a subject to be examined is disposed. A series of radio frequency pulses and magnetic field gradients are applied to the examination region. Gradient fields are conventionally applied as a series of gradient pulses with preselected profiles. These radio frequency and gradient pulses excite magnetic resonance, phase and frequency encode the resonance, and cause phase and frequency encoded magnetic resonance signals to be emitted.

BSPR:
More specifically, the gradient magnetic pulses are applied to select and encode the magnetic resonance. In some embodiments, the magnetic field gradients are applied to select one or more planes or slices to be imaged. Gradient field pulses are also applied for selectively modifying the uniform magnetic field to encode frequency and phase into the magnetization, hence the resonance signals, in order to identify a spatial location.

BSPR:
The magnetic resonance signals are then processed to generate two or three dimensional image representations of a portion of the subject in the examination region. The accuracy of the resultant image representation is dependent upon the accuracy, among other factors, with which the actually applied magnetic field gradient pulses conform to selected gradient pulse profiles.

BSPR:
Linear magnetic field gradients are commonly produced by cylindrical gradient field coils. Discrete coils are wound in a bunched or distributed fashion on a large diameter hollow right cylinder tube, commonly 65 centimeters in diameter or larger. Conventional bunched geometries include Maxwell or modified-Maxwell pairs for z-gradient production and single or multi-arc Golay saddle coils for x and y gradient production. The coils are normally wound in a series

arrangement and positioned to give a magnetic field profile with the desired linearity over a predefined volume. The distributive windings on the cylinders are generally wound and in pairs and driven anti-symmetrically. The coils are driven in an anti-symmetric manner such that only odd derivatives are non-zero at the coil origin. The first derivative is the field gradient while the third and higher order derivatives represent distortion. If the diameter of the cylinder and coil placement are chosen properly, the third derivative is canceled at the origin making the relatively weak fifth derivative component the first distortion term.

BSPR:
For maximum efficiency, it would be advantageous to reduce the diameter of the gradient coil cylinders to be as close as possible to the subject, provided gradient linearity can be maintained. The required energy for field gradient production varies roughly as a fifth power of a gradient coil cylinder diameter in free space. In an actual magnetic resonance imager, the gradient coils interact with other adjoining structures, such as radiation shields of superconducting magnets, making the relationship somewhat greater than the fifth power. Thus, reducing the coil size has a dramatic effect on power consumption.

BSPR:
In accordance with a more limited aspect of the present invention, each double spiral includes a larger ring of coils disposed symmetrically relative to the central axis, a smaller ring of coils axially offset from the first ring of coils, and a third ring of coils surrounding the first and second rings.

BSPR:
In accordance with a further aspect of the present invention, the axial gradient coil includes a first, denser group of coils adjacent one edge of the coil, a second, less dense group of windings adjacent the first, a third, more dense group of windings adjacent the second, and a fourth, less dense group of windings adjacent the third.

BSPR:
In accordance with a still more limited aspect of the present invention, the first and third coil winding groups include windings with opposite current flows.

DRPR:
FIG. 1 is a diagrammatic illustration of a magnetic resonance imaging apparatus with a magnetic field gradient coil in accordance with the present invention;

DEPR:
A resonance excitation means includes a radio frequency transmitter 42 for generating radio frequency pulses of the appropriate frequency spectrum for inducing resonance in selected dipoles disposed in the examination region. The radio frequency transmitter is connected to a radio frequency antenna 44 disposed adjacent the examination region for transmitting radio frequency pulses into a region of interest of the patient or other subject in the examination region. Although the radio frequency antenna is illustrated as being disposed peripherally around the gradient coil assemblies, it is to be appreciated that such antenna may also be disposed within the gradient coil assemblies. For example, a surface coil may be positioned contiguous to an examined patient or subject for controllably inducing magnetic resonance in a selected contiguous region of the patient.

DEPR:
A magnetic resonance receiving means 50 includes the radio frequency coil 44 which receives, as well as transmits, radio frequency signals in the illustrated embodiment. For other studies, separate transmit and receive coils are used. For example, receive only surface coils may be disposed contiguous to a selected region of the patient to receive resonance signals induced by the radio frequency coil 44. A radio frequency receiver 52 receives the radio frequency signals from the antenna 44. The received radio frequency signals are demodulated and reconstructed into an image representation. More specifically, a Fourier transform means 54 performs an inverse two-dimensional fast Fourier transform on the magnetic resonance signals to transform them into an image representation for storage in an image memory means 56. As is conventional in the art, the image may represent a planar slice through the patient, an array of parallel planar slices, a three dimensional volume, or the like. A display means 58, such as a video monitor, provides a man-readable display of the resultant image. Other conventional processing equipment, which is conventional in the art, is omitted from the illustration for simplicity.

DEPR:
With reference to FIG. 2, the z-gradient coil 22 includes a plurality of distributed windings encircling the z-axis. The distributed windings include a first loop array 70 adjacent the first end 32. The first loop array is a relatively dense winding assembly in which most of the windings convey current in a first (counterclockwise in the illustrated embodiment) direction. However, at least one of the windings 72 disposed closely adjacent an edge of the z-gradient coil conducts current in an opposite direction. A second group of windings 74 is disposed adjacent an interior edge of the first loop array. The second loop array is relatively sparse compared to the first loop array. A third loop array 76 is disposed adjacent an interior edge of the second loop array. The third loop array is divided between loops 78 carrying current in the first and loops 80 carrying current in a second, opposite direction (clockwise in the illustrated embodiment).

DEPR:
A fourth, relatively sparse loop array region 82 and a fifth loop array region 84 are disposed adjacent the third loop array. Currents in the fourth loop array region and the fifth loop array are directed in the second, clockwise direction. A sixth loop array 86 is disposed adjacent the fifth loop array at an opposite end of the z-gradient coil. Currents through the sixth loop array are primarily in the second direction.

DEPR:
With reference to FIG. 3, the x and y-gradient coils each include two windings disposed symmetrically on opposite sides of a plane along the z-axis. Each winding of the x and y-gradient coil includes a first, peripheral array of loops 90 through which current flows in a first (counterclockwise in the illustrated embodiment) direction. The first loop array bellies-in 92 adjacent the first end 32, i.e. adjacent the examination region, and fans out 94 away from the examination region 12. Each loop array further defines a second or major interior loop 96 in which currents flow in the first direction and a third loop array 98 in which the currents also flow in the first or counterclockwise direction. The two interior loop arrays 96, 98 are disposed generally symmetrically about a central axis of the coil with the major interior loop array disposed offset toward the first end 32 and the minor

interior loop array 98 disposed between the major loop and the first end of the gradient coil.

DEPR:
The coils are preferably wound with a conductor of rectangular cross-section with the turns lying alongside of one another in a direction parallel to the axis of the cylindrical volume which they surround. It will be appreciated that while referring to the embodiment of FIG. 4, the cylindrical volume is of circular cross-section, this is not necessary. In other embodiments of the invention, the volume may have other cross-sections, particularly an elliptical cross-section.

DEPR:
With reference to FIG. 6, the formers 60, 62 are shaped with an ellipse or ovoid cross sectional shape which better matches the cross-section of the patient's head or other body region that is to be imaged. The x-gradient coil windings become elongated in the y-direction, but are otherwise unchanged. Analogously, the y-coils become compressed in the x-direction, if the minor axis of the ellipse is smaller than the radius of the circle.

CLPR:
1. A magnetic resonance imaging apparatus comprising:

CLPR:
5. The apparatus as set forth in claim 4 wherein the first, third, and fifth loop arrays have a higher current flux density than the second and sixth current loop arrays.

CLPR:
8. The apparatus as set forth in claim 7 wherein the first loop array bellies-in adjacent the third loop array and fans-out adjacent a second end of the coil.

CLPR:
11. The apparatus as set forth in claim 10 wherein the first and second cylindrical formers are generally elliptical in cross-section.

CLPR:
18. A gradient coil for a magnetic resonance apparatus, the gradient coil comprising:

CLPR:
20. A gradient coil for a magnetic resonance apparatus, the gradient coil comprising:

CLPR:
21. The gradient coil assembly as set forth in claim 20 further including a current supply for supplying current to the loop arrays such that the first and second loop arrays have a primary current flow in a first circumferential direction, said fifth loop array has a primary current flow in a second circumferential direction opposite the first, and the third loop array has current flows in both the first and the second circumferential directions.

CLPR:
23. A gradient coil for a magnetic resonance apparatus, the gradient coil comprising:

CLPR:

24. A magnetic resonance method comprising:

CLPR:
25. A coil set in a magnetic resonance apparatus for imposing on a magnetic field in a cylindrical volume in which an object to be examined is placed in use of the apparatus a gradient in a direction transverse to the axis of the volume, the coil set effectively comprising a pair of coils correspondingly positioned around said volume diametrically opposite one another, each of said coils having an axial end portion in which the conductors of the coil are spaced apart axially, and which is substantially radially aligned with said volume.

CLPR:
30. A magnetic resonance apparatus comprising:

CLPR:
31. A z-gradient coil for generating magnetic field gradients along a z-axis through an examination region of a magnetic resonance apparatus, the z-gradient coil comprising:

CLPR:
32. A magnetic resonance apparatus comprising:

CLPV:
a magnetic resonance excitation means for selectively exciting magnetic resonance in dipoles disposed in the examination region;

CLPV:
a z-gradient coil disposed generally along a cylindrical surface extending circumferentially around a central axis for generating linear magnetic field gradients across the examination region in a third direction generally parallel to the central axis,

CLPV:
a magnetic resonance signal receiving means for receiving magnetic resonance signals from the resonating dipoles; and,

CLPV:
a processing means for processing the magnetic resonance signals.

CLPV:
a third loop array disposed adjacent the second loop array;

CLPV:
a fourth loop array region disposed adjacent the third loop array;

CLPV:
a fifth loop array disposed adjacent the fourth loop array region; and,

CLPV:
a coil current supply means for supplying currents through the first, second, third, and fifth loop arrays such that (a) the first loop array has a current density primarily in a first circumferential direction, (b) the second loop array has a net current flux in the first circumferential direction, the second loop array having a smaller net current flux density than the first loop array, (c) the third loop array has current fluxes in the first circumferential direction and in a second circumferential direction opposite to the first,.and (d) the fifth loop array has a net current flux in the second circumferential

direction.

CLPV:
a third loop array disposed within the peripheral first array between the second loop array and a first end.

CLPV:
a third loop array disposed adjacent the second loop array;

CLPV:
a fourth loop array region disposed adjacent the third loop array;

CLPV:
a fifth loop array disposed adjacent the fourth loop array region; and

CLPV:
a current supply means for supplying currents through the first, second, third, and fifth loop arrays such that the first loop array has a current density primarily in a first circumferential direction, the second loop array has a smaller net current flux than the first loop array in the first circumferential direction, the third loop array has current fluxes in the first circumferential direction and in a second circumferential direction opposite to the first, and the fifth loop array has a net current flux in the second circumferential direction.

CLPV:
a third loop array disposed adjacent the second loop array;

CLPV:
a fourth loop array region disposed adjacent the third loop array;

CLPV:
a fifth loop array, the first, third, and fifth loop arrays having denser winding pattern than the second loop array and the fourth loop array region.

CLPV:
a pair of windings disposed opposite each other across the cylindrical former, each of the windings having a first, outer spiral winding which bows in adjacent a first end of the cylindrical former and fans out adjacent a second end of the cylindrical former, a second spiral winding and a third spiral winding, the second and third spiral windings being disposed adjacent to each other and within the first spiral winding, the second and third spiral windings being offset towards the first end of the former.

CLPV:
exciting dipoles in the examination region to magnetic resonance;

CLPV:
passing currents along a multiplicity of circumferential currents paths defined by the gradient coil assembly with an asymmetric current density which is denser adjacent the examination region to generate gradient magnetic fields along a third direction through the examination region.

CLPV:
a magnetic resonance excitation means for selectively exciting magnetic resonance in dipoles disposed in the examination region;

CLPV:
a magnetic resonance signal receiving means for receiving magnetic resonance signals from the resonating dipoles; and,

CLPV:
a processing means for processing the magnetic resonance signals.

CLPV:
a magnetic resonance excitation means for selectively exciting magnetic resonance in dipoles disposed in the examination region;

CLPV:
a magnetic resonance signal receiving means for receiving magnetic resonance signals from the resonating dipoles; and

CLPV:
a processing means for processing the magnetic resonance signals.

ORPL:
P. Mansfield and P. G. Morris, "NMR Imaging in Biomedicine", Academic Press, 1982.

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US Pre-Grant Publication Full-Text Database
JPO Abstracts Database
EPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

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☐ 1. Document ID: US 6196047 B1

L5: Entry 1 of 21 File: USPT Mar 6, 2001

US-PAT-NO: 6196047
DOCUMENT-IDENTIFIER: US 6196047 B1

TITLE: Method and system to measure torque per unit current as a function of angle in hard disk drive actuators

DATE-ISSUED: March 6, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Carnegie; David W.	Valparaiso	IN	N/A	N/A
Wise; James H.	Valparaiso	IN	N/A	N/A

US-CL-CURRENT: 73/1.11; 73/862.541

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 2. Document ID: US 6054855 A

L5: Entry 2 of 21 File: USPT Apr 25, 2000

US-PAT-NO: 6054855
DOCUMENT-IDENTIFIER: US 6054855 A

TITLE: Magnetic susceptibility control of superconducting materials in nuclear magnetic resonance (NMR) probes

DATE-ISSUED: April 25, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/307

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 3. Document ID: US 6025719 A

L5: Entry 3 of 21 File: USPT Feb 15, 2000

US-PAT-NO: 6025719
DOCUMENT-IDENTIFIER: US 6025719 A

TITLE: Nuclear magnetic resonance method and apparatus

DATE-ISSUED: February 15, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/315

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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4. Document ID: US 5999000 A

L5: Entry 4 of 21   File: USPT   Dec 7, 1999

US-PAT-NO: 5999000
DOCUMENT-IDENTIFIER: US 5999000 A

TITLE: Radio-frequency coil and method for resonance imaging/analysis

DATE-ISSUED: December 7, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Srinivasan; Ravi	Richmond Heights	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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5. Document ID: US 5790006 A

L5: Entry 5 of 21   File: USPT   Aug 4, 1998

US-PAT-NO: 5790006
DOCUMENT-IDENTIFIER: US 5790006 A

TITLE: Apparatus for generating uniform magnetic fields with magnetic wedges

DATE-ISSUED: August 4, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A
Rusinek; Henry	Great Neck	NY	N/A	N/A
Jensen; Jens	Harrison	NY	N/A	N/A

US-CL-CURRENT: 335/306; 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 6. Document ID: US 5777474 A

L5: Entry 6 of 21 File: USPT Jul 7, 1998

US-PAT-NO: 5777474
DOCUMENT-IDENTIFIER: US 5777474 A

TITLE: Radio-frequency coil and method for resonance imaging/analysis

DATE-ISSUED: July 7, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Srinivasan; Ravi	Richmond Heights	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 7. Document ID: US 5659281 A

L5: Entry 7 of 21 File: USPT Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 8. Document ID: US 5491411 A

L5: Entry 8 of 21 File: USPT Feb 13, 1996

US-PAT-NO: 5491411
DOCUMENT-IDENTIFIER: US 5491411 A

TITLE: Method and apparatus for imaging microscopic spatial variations in small currents and magnetic fields

DATE-ISSUED: February 13, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wellstood; Frederick C.	College Park	MD	N/A	N/A
Mathai; Anna	University Park	MD	N/A	N/A
Song; Dian	Greenbelt	MD	N/A	N/A
Black; Randall C.	Seabrook	MD	N/A	N/A

US-CL-CURRENT: 324/248; 324/201, 324/224, 324/235, 324/239, 324/262, 324/750, 505/162, 505/846

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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9. Document ID: US 5441495 A

L5: Entry 9 of 21 File: USPT Aug 15, 1995

US-PAT-NO: 5441495
DOCUMENT-IDENTIFIER: US 5441495 A

TITLE: Electromagnetic treatment therapy for stroke victim

DATE-ISSUED: August 15, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Liboff; Abraham R.	Birmingham	MI	N/A	N/A
McLeod; Bruce R.	Bozeman	MT	N/A	N/A
Smith; Stephen D.	Lexington	KY	N/A	N/A

US-CL-CURRENT: 600/9; 600/13

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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10. Document ID: US 5426366 A

L5: Entry 10 of 21 File: USPT Jun 20, 1995

US-PAT-NO: 5426366
DOCUMENT-IDENTIFIER: US 5426366 A

TITLE: Magnetic resonance apparatus comprising a superconducting magnet

DATE-ISSUED: June 20, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Overweg; Johannes A.	Bergisch Gladbach	N/A	N/A	DEX
Mulder; Gerardus B. J.	Eindhoven	N/A	N/A	NLX

US-CL-CURRENT: 324/319; 324/318, 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 11. Document ID: US 5382904 A

L5: Entry 11 of 21 File: USPT Jan 17, 1995

US-PAT-NO: 5382904
DOCUMENT-IDENTIFIER: US 5382904 A

TITLE: Structured coil electromagnets for magnetic resonance imaging and method for fabricating the same

DATE-ISSUED: January 17, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A

US-CL-CURRENT: 324/319; 29/602.1, 324/320, 335/296

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 12. Document ID: US 5326986 A

L5: Entry 12 of 21 File: USPT Jul 5, 1994

US-PAT-NO: 5326986
DOCUMENT-IDENTIFIER: US 5326986 A

TITLE: Parallel N-junction superconducting interferometer with enhanced flux-to-voltage transfer function

DATE-ISSUED: July 5, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Miller, Jr.; John H.	Houston	TX	N/A	N/A
Golding; Terry D.	Houston	TX	N/A	N/A
Huang; Jaiming	Houston	TX	N/A	N/A

US-CL-CURRENT: 505/162; 257/31, 257/36, 257/39, 257/661, 257/662, 257/663, 324/248, 327/186, 327/373, 327/527, 505/702, 505/846, 505/861

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 13. Document ID: US 5315276 A

L5: Entry 13 of 21 File: USPT May 24, 1994

US-PAT-NO: 5315276
DOCUMENT-IDENTIFIER: US 5315276 A

TITLE: Compact superconducting magnet for magnetic resonance imaging

DATE-ISSUED: May 24, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Huson; F. Russell	The Woodlands	TX	N/A	N/A
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
Larson, III; John D.	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 335/216; 324/319, 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 14. Document ID: US 5296810 A

L5: Entry 14 of 21 File: USPT Mar 22, 1994

US-PAT-NO: 5296810
DOCUMENT-IDENTIFIER: US 5296810 A

TITLE: MRI self-shielded gradient coils

DATE-ISSUED: March 22, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Morich; Michael A.	Mentor	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/319

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 15. Document ID: US 5162770 A

L5: Entry 15 of 21   File: USPT   Nov 10, 1992

US-PAT-NO: 5162770
DOCUMENT-IDENTIFIER: US 5162770 A

TITLE: Terminations of cylindrical permanent magnets

DATE-ISSUED: November 10, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/306; 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 16. Document ID: US 5119057 A

L5: Entry 16 of 21   File: USPT   Jun 2, 1992

US-PAT-NO: 5119057
DOCUMENT-IDENTIFIER: US 5119057 A

TITLE: Optimum design of two-dimensional permanent magnets

DATE-ISSUED: June 2, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/304; 335/306

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

☐ 17. Document ID: US 4998083 A

L5: Entry 17 of 21 File: USPT Mar 5, 1991

US-PAT-NO: 4998083
DOCUMENT-IDENTIFIER: US 4998083 A

TITLE: Yokeless permanent magnet structure and method of construction

DATE-ISSUED: March 5, 1991

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/302; 29/607, 335/306

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

☐ 18. Document ID: US 4871969 A

L5: Entry 18 of 21 File: USPT Oct 3, 1989

US-PAT-NO: 4871969
DOCUMENT-IDENTIFIER: US 4871969 A

TITLE: RF shield for RF coil contained within gradient coils of NMR imaging device

DATE-ISSUED: October 3, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Roemer; Peter B.	Schenectady	NY	N/A	N/A
Edelstein; William A.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 324/318; 324/300

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

☐ 19. Document ID: US 4810986 A

L5: Entry 19 of 21 File: USPT Mar 7, 1989

US-PAT-NO: 4810986
DOCUMENT-IDENTIFIER: US 4810986 A

TITLE: Local preservation of infinite, uniform magnetization field configuration under source truncation

DATE-ISSUED: March 7, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Leupold; Herbert A.	Eatontown	NJ	N/A	N/A

US-CL-CURRENT: 335/301; 335/304

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 20. Document ID: US 4584549 A

L5: Entry 20 of 21 File: USPT Apr 22, 1986

US-PAT-NO: 4584549
DOCUMENT-IDENTIFIER: US 4584549 A

TITLE: Magnet system

DATE-ISSUED: April 22, 1986

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Brown; Ian J.	Oxon	N/A	N/A	GB2
Bird; John M.	Oxon	N/A	N/A	GB2

US-CL-CURRENT: 335/301; 324/320, 335/211

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 21. Document ID: US 4236964 A

L5: Entry 21 of 21 File: USPT Dec 2, 1980

US-PAT-NO: 4236964
DOCUMENT-IDENTIFIER: US 4236964 A

TITLE: Confinement of high temperature plasmas

DATE-ISSUED: December 2, 1980

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 1. Document ID: US 6054855 A

L7: Entry 1 of 17 File: USPT Apr 25, 2000

US-PAT-NO: 6054855
DOCUMENT-IDENTIFIER: US 6054855 A

TITLE: Magnetic susceptibility control of superconducting materials in nuclear magnetic resonance (NMR) probes

DATE-ISSUED: April 25, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/307

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 2. Document ID: US 6025719 A

L7: Entry 2 of 17 File: USPT Feb 15, 2000

US-PAT-NO: 6025719
DOCUMENT-IDENTIFIER: US 6025719 A

TITLE: Nuclear magnetic resonance method and apparatus

DATE-ISSUED: February 15, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/315

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 3. Document ID: US 5999000 A

L7: Entry 3 of 17 File: USPT Dec 7, 1999

US-PAT-NO: 5999000
DOCUMENT-IDENTIFIER: US 5999000 A

TITLE: Radio-frequency coil and method for resonance imaging/analysis

DATE-ISSUED: December 7, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Srinivasan; Ravi	Richmond Heights	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw. Desc | Image

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4. Document ID: US 5790006 A

L7: Entry 4 of 17   File: USPT   Aug 4, 1998

US-PAT-NO: 5790006
DOCUMENT-IDENTIFIER: US 5790006 A

TITLE: Apparatus for generating uniform magnetic fields with magnetic wedges

DATE-ISSUED: August 4, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A
Rusinek; Henry	Great Neck	NY	N/A	N/A
Jensen; Jens	Harrison	NY	N/A	N/A

US-CL-CURRENT: 335/306; 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw. Desc | Image

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5. Document ID: US 5777474 A

L7: Entry 5 of 17   File: USPT   Jul 7, 1998

US-PAT-NO: 5777474
DOCUMENT-IDENTIFIER: US 5777474 A

TITLE: Radio-frequency coil and method for resonance imaging/analysis

DATE-ISSUED: July 7, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Srinivasan; Ravi	Richmond Heights	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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6. Document ID: US 5659281 A

L7: Entry 6 of 17 File: USPT Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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7. Document ID: US 5441495 A

L7: Entry 7 of 17 File: USPT Aug 15, 1995

US-PAT-NO: 5441495
DOCUMENT-IDENTIFIER: US 5441495 A

TITLE: Electromagnetic treatment therapy for stroke victim

DATE-ISSUED: August 15, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Liboff; Abraham R.	Birmingham	MI	N/A	N/A
McLeod; Bruce R.	Bozeman	MT	N/A	N/A
Smith; Stephen D.	Lexington	KY	N/A	N/A

US-CL-CURRENT: 600/9; 600/13

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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8. Document ID: US 5426366 A

L7: Entry 8 of 17 File: USPT Jun 20, 1995

US-PAT-NO: 5426366
DOCUMENT-IDENTIFIER: US 5426366 A

TITLE: Magnetic resonance apparatus comprising a superconducting magnet

DATE-ISSUED: June 20, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Overweg; Johannes A.	Bergisch Gladbach	N/A	N/A	DEX
Mulder; Gerardus B. J.	Eindhoven	N/A	N/A	NLX

US-CL-CURRENT: 324/319; 324/318, 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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9. Document ID: US 5382904 A

L7: Entry 9 of 17   File: USPT   Jan 17, 1995

US-PAT-NO: 5382904
DOCUMENT-IDENTIFIER: US 5382904 A

TITLE: Structured coil electromagnets for magnetic resonance imaging and method for fabricating the same

DATE-ISSUED: January 17, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A

US-CL-CURRENT: 324/319; 29/602.1, 324/320, 335/296

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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10. Document ID: US 5315276 A

L7: Entry 10 of 17   File: USPT   May 24, 1994

US-PAT-NO: 5315276
DOCUMENT-IDENTIFIER: US 5315276 A

TITLE: Compact superconducting magnet for magnetic resonance imaging

DATE-ISSUED: May 24, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Huson; F. Russell	The Woodlands	TX	N/A	N/A
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
Larson, III; John D.	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 335/216; 324/319, 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 11. Document ID: US 5162770 A

L7: Entry 11 of 17   File: USPT   Nov 10, 1992

US-PAT-NO: 5162770
DOCUMENT-IDENTIFIER: US 5162770 A

TITLE: Terminations of cylindrical permanent magnets

DATE-ISSUED: November 10, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/306; 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 12. Document ID: US 5119057 A

L7: Entry 12 of 17   File: USPT   Jun 2, 1992

US-PAT-NO: 5119057
DOCUMENT-IDENTIFIER: US 5119057 A

TITLE: Optimum design of two-dimensional permanent magnets

DATE-ISSUED: June 2, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/304; 335/306

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

13. Document ID: US 4998083 A

L7: Entry 13 of 17 File: USPT Mar 5, 1991

US-PAT-NO: 4998083
DOCUMENT-IDENTIFIER: US 4998083 A

TITLE: Yokeless permanent magnet structure and method of construction

DATE-ISSUED: March 5, 1991

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/302; 29/607, 335/306

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

14. Document ID: US 4871969 A

L7: Entry 14 of 17 File: USPT Oct 3, 1989

US-PAT-NO: 4871969
DOCUMENT-IDENTIFIER: US 4871969 A

TITLE: RF shield for RF coil contained within gradient coils of NMR imaging device

DATE-ISSUED: October 3, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Roemer; Peter B.	Schenectady	NY	N/A	N/A
Edelstein; William A.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 324/318; 324/300

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

15. Document ID: US 4810986 A

L7: Entry 15 of 17 File: USPT Mar 7, 1989

US-PAT-NO: 4810986
DOCUMENT-IDENTIFIER: US 4810986 A

TITLE: Local preservation of infinite, uniform magnetization field configuration under source truncation

DATE-ISSUED: March 7, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Leupold; Herbert A.	Eatontown	NJ	N/A	N/A

US-CL-CURRENT: 335/301; 335/304

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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16. Document ID: US 4584549 A

L7: Entry 16 of 17   File: USPT   Apr 22, 1986

US-PAT-NO: 4584549
DOCUMENT-IDENTIFIER: US 4584549 A

TITLE: Magnet system

DATE-ISSUED: April 22, 1986

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Brown; Ian J.	Oxon	N/A	N/A	GB2
Bird; John M.	Oxon	N/A	N/A	GB2

US-CL-CURRENT: 335/301; 324/320, 335/211

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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17. Document ID: US 4236964 A

L7: Entry 17 of 17   File: USPT   Dec 2, 1980

US-PAT-NO: 4236964
DOCUMENT-IDENTIFIER: US 4236964 A

TITLE: Confinement of high temperature plasmas

DATE-ISSUED: December 2, 1980

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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Term	Documents
COIL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	682814
COILS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	217404
LOOP.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	479781
LOOPS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	132762
RING.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1329687
RINGS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	352334
ANNULAR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	638917
ANNULARS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	26
(6 AND (LOOP OR ANNULAR OR COIL OR RING)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	17

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Search Results - Record(s) 1 through 10 of 10 returned.

☐ 1. Document ID: US 5790006 A

L10: Entry 1 of 10 File: USPT Aug 4, 1998

US-PAT-NO: 5790006
DOCUMENT-IDENTIFIER: US 5790006 A

TITLE: Apparatus for generating uniform magnetic fields with magnetic wedges

DATE-ISSUED: August 4, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A
Rusinek; Henry	Great Neck	NY	N/A	N/A
Jensen; Jens	Harrison	NY	N/A	N/A

US-CL-CURRENT: 335/306; 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 2. Document ID: US 5659281 A

L10: Entry 2 of 10 File: USPT Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 3. Document ID: US 5441495 A

L10: Entry 3 of 10 File: USPT Aug 15, 1995

US-PAT-NO: 5441495
DOCUMENT-IDENTIFIER: US 5441495 A

TITLE: Electromagnetic treatment therapy for stroke victim

DATE-ISSUED: August 15, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Liboff; Abraham R.	Birmingham	MI	N/A	N/A
McLeod; Bruce R.	Bozeman	MT	N/A	N/A
Smith; Stephen D.	Lexington	KY	N/A	N/A

US-CL-CURRENT: 600/9; 600/13

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 4. Document ID: US 5382904 A

L10: Entry 4 of 10   File: USPT   Jan 17, 1995

US-PAT-NO: 5382904
DOCUMENT-IDENTIFIER: US 5382904 A

TITLE: Structured coil electromagnets for magnetic resonance imaging and method for fabricating the same

DATE-ISSUED: January 17, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A

US-CL-CURRENT: 324/319; 29/602.1, 324/320, 335/296

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 5. Document ID: US 5315276 A

L10: Entry 5 of 10   File: USPT   May 24, 1994

US-PAT-NO: 5315276
DOCUMENT-IDENTIFIER: US 5315276 A

TITLE: Compact superconducting magnet for magnetic resonance imaging

DATE-ISSUED: May 24, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Huson; F. Russell	The Woodlands	TX	N/A	N/A
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
Larson, III; John D.	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 335/216; 324/319, 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 6. Document ID: US 5162770 A

L10: Entry 6 of 10   File: USPT   Nov 10, 1992

US-PAT-NO: 5162770
DOCUMENT-IDENTIFIER: US 5162770 A

TITLE: Terminations of cylindrical permanent magnets

DATE-ISSUED: November 10, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/306; 335/301

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 7. Document ID: US 4998083 A

L10: Entry 7 of 10   File: USPT   Mar 5, 1991

US-PAT-NO: 4998083
DOCUMENT-IDENTIFIER: US 4998083 A

TITLE: Yokeless permanent magnet structure and method of construction

DATE-ISSUED: March 5, 1991

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Abele; Manlio G.	New York	NY	N/A	N/A

US-CL-CURRENT: 335/302; 29/607, 335/306

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw. Desc | Image

8. Document ID: US 4871969 A

L10: Entry 8 of 10 File: USPT Oct 3, 1989

US-PAT-NO: 4871969
DOCUMENT-IDENTIFIER: US 4871969 A

TITLE: RF shield for RF coil contained within gradient coils of NMR imaging device

DATE-ISSUED: October 3, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Roemer; Peter B.	Schenectady	NY	N/A	N/A
Edelstein; William A.	Schenectady	NY	N/A	N/A

US-CL-CURRENT: 324/318; 324/300

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw. Desc | Image

9. Document ID: US 4810986 A

L10: Entry 9 of 10 File: USPT Mar 7, 1989

US-PAT-NO: 4810986
DOCUMENT-IDENTIFIER: US 4810986 A

TITLE: Local preservation of infinite, uniform magnetization field configuration under source truncation

DATE-ISSUED: March 7, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Leupold; Herbert A.	Eatontown	NJ	N/A	N/A

US-CL-CURRENT: 335/301; 335/304

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw. Desc | Image

10. Document ID: US 4236964 A

L10: Entry 10 of 10 File: USPT Dec 2, 1980

US-PAT-NO: 4236964
DOCUMENT-IDENTIFIER: US 4236964 A

TITLE: Confinement of high temperature plasmas

DATE-ISSUED: December 2, 1980

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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Term	Documents
SINGLE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1910160
SINGLES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1723
ONE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	7137091
ONES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	316462
PAIR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1759836
PAIRS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	478774
(9 AND (SINGLE OR PAIR OR ONE)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	10

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Display Format: CIT Change Format

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Search Results - Record(s) 1 through 4 of 4 returned.

☐ 1. Document ID: US 5659281 A

L11: Entry 1 of 4 File: USPT Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw. Desc | Image

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☐ 2. Document ID: US 5441495 A

L11: Entry 2 of 4 File: USPT Aug 15, 1995

US-PAT-NO: 5441495
DOCUMENT-IDENTIFIER: US 5441495 A

TITLE: Electromagnetic treatment therapy for stroke victim

DATE-ISSUED: August 15, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Liboff; Abraham R.	Birmingham	MI	N/A	N/A
McLeod; Bruce R.	Bozeman	MT	N/A	N/A
Smith; Stephen D.	Lexington	KY	N/A	N/A

US-CL-CURRENT: 600/9; 600/13

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw. Desc | Image

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☐ 3. Document ID: US 5382904 A

L11: Entry 3 of 4 File: USPT Jan 17, 1995

US-PAT-NO: 5382904
DOCUMENT-IDENTIFIER: US 5382904 A

TITLE: Structured coil electromagnets for magnetic resonance imaging and method for fabricating the same

DATE-ISSUED: January 17, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A

US-CL-CURRENT: 324/319; 29/602.1, 324/320, 335/296

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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4. Document ID: US 4236964 A

L11: Entry 4 of 4   File: USPT   Dec 2, 1980

US-PAT-NO: 4236964
DOCUMENT-IDENTIFIER: US 4236964 A

TITLE: Confinement of high temperature plasmas

DATE-ISSUED: December 2, 1980

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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Term	Documents
HELMHOLTZ.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	3437
HELMHOLTZES	0
(10 AND HELMHOLTZ).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	4

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Search Results - Record(s) 1 through 2 of 2 returned.

☐ 1. Document ID: US 5659281 A

L12: Entry 1 of 2 File: USPT Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

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☐ 2. Document ID: US 4236964 A

L12: Entry 2 of 2 File: USPT Dec 2, 1980

US-PAT-NO: 4236964
DOCUMENT-IDENTIFIER: US 4236964 A

TITLE: Confinement of high temperature plasmas

DATE-ISSUED: December 2, 1980

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

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Term	Documents
ELLIPSE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	25832
ELLIPSES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4621
ELLIPTICAL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	66826
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(10 AND (ELLIPSE OR ELLIPTICAL)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	2

Display 50 Documents, starting with Document: 2

Display Format: CIT Change Format

WEST

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Search Results - Record(s) 1 through 2 of 2 returned.

☐ 1. Document ID: US 5659281 A

L13: Entry 1 of 2 File: USPT Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 2. Document ID: US 4236964 A

L13: Entry 2 of 2 File: USPT Dec 2, 1980

US-PAT-NO: 4236964
DOCUMENT-IDENTIFIER: US 4236964 A

TITLE: Confinement of high temperature plasmas

DATE-ISSUED: December 2, 1980

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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Term	Documents
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Display Format: CIT Change Format

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Search Results - Record(s) 1 through 1 of 1 returned.

☐ 1. Document ID: US 5426366 A

L14: Entry 1 of 1 File: USPT Jun 20, 1995

US-PAT-NO: 5426366
DOCUMENT-IDENTIFIER: US 5426366 A

TITLE: Magnetic resonance apparatus comprising a superconducting magnet

DATE-ISSUED: June 20, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Overweg; Johannes A.	Bergisch Gladbach	N/A	N/A	DEX
Mulder; Gerardus B. J.	Eindhoven	N/A	N/A	NLX

US-CL-CURRENT: 324/319; 324/318, 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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(8 NOT 9).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	1

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ELLIPSE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	25832
ELLIPSES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4621
ELLIPTICAL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	66826
ELLIPTICALS	0
ELLIPTICALLY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	8138
ELLIPTICALLIES	0
ELLIPTICALLYS	0
(16 AND (ELLIPTICALLY OR ELLIPSE OR ELLIPTICAL)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	14

Database: US Patents Full-Text Database
US Pre-Grant Publication Full-Text Database
JPO Abstracts Database
EPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Refine Search: l16 and (ellipse or elliptical or elliptically) Clear

Search History

Today's Date: 9/19/2001

DB Name	Query	Hit Count	Set Name
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l16 and (ellipse or elliptical or elliptically)	14	L19
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l17 and (ellipse or elliptical or elliptically)	3	L18
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l16 and (Helmholtz)	13	L17
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l15 and ((magnetic adj resonance) or MRI or NMR)	132	L16
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 or l10	5670	L15
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l11 and (ellipse or elliptical or elliptically)	1	L14
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l12 and (ellipse or elliptical or elliptically)	0	L13
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l11 and (Helmholtz)	3	L12
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l10 and ((magnetic adj resonance) or MRI or NMR)	6	L11
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	(zero-flux or (zero adj flux))	407	L10
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l6 and (Helmholtz)	2	L9
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l7 and (Helmholtz)	0	L8
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l6 and (ellipse or elliptical or elliptically)	1	L7
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l5 and ((magnetic adj resonance) or MRI or NMR)	5	L6
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l4 and ((position$ or locat$) with (flux with zero))	284	L5
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and ((single or one) with coil)	1468	L4
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	(flux with zero)	5670	L3
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	(zero-flux with contour)	0	L2
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	(((((((((((magnetic adj resonance) or MRI or NMR))and (flux))and (contour or (field adj line) or field-line))and (zero or "0"))and ((zero with flux) or zero-flux))and (plane))and (coil or loop or ring or annular))and (series))and (parallel)) and (single or one or pair))	10	L1

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Search Results - Record(s) 1 through 6 of 6 returned.

☐ 1. Document ID: US 6214019 B1

L11: Entry 1 of 6 File: USPT Apr 10, 2001

US-PAT-NO: 6214019
DOCUMENT-IDENTIFIER: US 6214019 B1

TITLE: Convergent magnetic stereotaxis system for guidance to a target

DATE-ISSUED: April 10, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Manwaring; Kim H.	Provo	UT	N/A	N/A
Manwaring; Mark L.	Pullman	WA	N/A	N/A

US-CL-CURRENT: 606/130

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw. Desc | Image

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☐ 2. Document ID: US 6054855 A

L11: Entry 2 of 6 File: USPT Apr 25, 2000

US-PAT-NO: 6054855
DOCUMENT-IDENTIFIER: US 6054855 A

TITLE: Magnetic susceptibility control of superconducting materials in nuclear magnetic resonance (NMR) probes

DATE-ISSUED: April 25, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/307

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw. Desc | Image

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☐ 3. Document ID: US 5986453 A

L11: Entry 3 of 6 File: USPT Nov 16, 1999

US-PAT-NO: 5986453
DOCUMENT-IDENTIFIER: US 5986453 A

TITLE: AC magnetic susceptibility control of superconducting materials in nuclear magnetic resonance (NMR) probes

DATE-ISSUED: November 16, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A
Withers; Richard S.	Sunnyvale	CA	N/A	N/A

US-CL-CURRENT: 324/300; 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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4. Document ID: US 4656447 A

L11: Entry 4 of 6   File: USPT   Apr 7, 1987

US-PAT-NO: 4656447
DOCUMENT-IDENTIFIER: US 4656447 A

TITLE: Superconducting filter coils for high homogeneity magnetic field

DATE-ISSUED: April 7, 1987

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Keim; Thomas A.	Clifton Park	NY	N/A	N/A
Mayergoyz; Isaak D.	Rockville	MD	N/A	N/A

US-CL-CURRENT: 335/216; 324/320, 335/299, 505/879

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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5. Document ID: US 3699428 A

L11: Entry 5 of 6   File: USPT   Oct 17, 1972

US-PAT-NO: 3699428
DOCUMENT-IDENTIFIER: US 3699428 A

TITLE: NUCLEAR MAGNETIC RESONANCE SPECTROMETER SYSTEM

DATE-ISSUED: October 17, 1972

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Leane; John Bryant	Beaconsfield	N/A	N/A	EN
Higham; Peter	High Wycombe	N/A	N/A	EN

US-CL-CURRENT: 324/311

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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6. Document ID: US 3673465 A

L11: Entry 6 of 6   File: USPT   Jun 27, 1972

US-PAT-NO: 3673465
DOCUMENT-IDENTIFIER: US 3673465 A

TITLE: STABILIZING MAGNETIC FIELDS

DATE-ISSUED: June 27, 1972

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Tschopp; Werner	Forch	N/A	N/A	CH

US-CL-CURRENT: 361/146

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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Term	Documents
MAGNETIC.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	1024347
MAGNETICS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	9110
RESONANCE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	185797
RESONANCES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	10107
MRI.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	11285
MRIS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	74
NMR.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	90194
NMRS.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	106
(10 AND (MRI OR (MAGNETIC ADJ RESONANCE) OR NMR)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	6

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L11: Entry 1 of 6 File: USPT Apr 10, 2001

US-PAT-NO: 6214019
DOCUMENT-IDENTIFIER: US 6214019 B1

TITLE: Convergent magnetic stereotaxis system for guidance to a target

DATE-ISSUED: April 10, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Manwaring; Kim H.	Provo	UT	N/A	N/A
Manwaring; Mark L.	Pullman	WA	N/A	N/A

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Brain Child Foundation	Carefree	AZ	N/A	N/A	02

APPL-NO: 9/ 349524
DATE FILED: July 8, 1999

INT-CL: [7] A61B 19/00
US-CL-ISSUED: 606/130
US-CL-CURRENT: 606/130
FIELD-OF-SEARCH: 606/129, 606/130, 600/114, 600/117

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3731752	May 1973	Schad	175/45
3822694	July 1974	Mills	600/407
4079730	March 1978	Wikswo, Jr. et al.	600/504
4176662	December 1979	Frazer	600/114
4608992	September 1986	Hakim et al.	600/431
4739771	April 1988	Manwaring	N/A
4927420	May 1990	Newkirk et al.	N/A
4955389	September 1990	Schneider	600/554
5122138	June 1992	Manwaring	N/A
5258755	November 1993	Kuckes	340/853.5
5566681	October 1996	Manwaring et al.	N/A
5711299	January 1998	Manwaring et al.	N/A
5762064	June 1998	Polvani	600/424
5769843	June 1998	Abela et al.	606/10
6052610	April 2000	Koch	600/424

ART-UNIT: 372
PRIMARY-EXAMINER: Mancene; Gene
ASSISTANT-EXAMINER: Robert; Eduardo C.
ATTY-AGENT-FIRM: Mayer, Brown & Platt

ABSTRACT:

A guidance system for guiding a surgical instrument without visual information to a target in tissue. The system centers the target upon the trajectory of an infinite family of zero-flux curvilinear lines emanating from either a fixed magnet or an ac or dc electromagnet which is mounted on the instrument. The approach to the target allows selection of straight and curved trajectories based on the zero-flux lines that intersect the target. A self-centering attachment that holds the magnet allows any straight instrument to be guided by the system. The zero-flux lines are measured by a magnetometer that is located on a remote location on or in the tissue. The transducers of the magnetometer measure the magnetic field strength that is present if the instrument deviates from the zero-flux line. The guidance information is plotted on a display that allows a user to guide the instrument along the zero-flux line to the target. An alternative embodiment uses a sensing magnetometer in the instrument tip that measures the field strength that is generated from a magnet that is placed on a remote location on or in the tissue.

28 Claims, 11 Drawing figures

[redacted]

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Search Results - Record(s) 1 through 3 of 3 returned.

☐ 1. Document ID: US 6054855 A

L12: Entry 1 of 3 File: USPT Apr 25, 2000

US-PAT-NO: 6054855
DOCUMENT-IDENTIFIER: US 6054855 A

TITLE: Magnetic susceptibility control of superconducting materials in nuclear magnetic resonance (NMR) probes

DATE-ISSUED: April 25, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A

US-CL-CURRENT: 324/318; 324/307

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw. Desc | Image

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☐ 2. Document ID: US 5986453 A

L12: Entry 2 of 3 File: USPT Nov 16, 1999

US-PAT-NO: 5986453
DOCUMENT-IDENTIFIER: US 5986453 A

TITLE: AC magnetic susceptibility control of superconducting materials in nuclear magnetic resonance (NMR) probes

DATE-ISSUED: November 16, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Anderson; Weston	Palo Alto	CA	N/A	N/A
Withers; Richard S.	Sunnyvale	CA	N/A	N/A

US-CL-CURRENT: 324/300; 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw. Desc | Image

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☐ 3. Document ID: US 3673465 A

L12: Entry 3 of 3 File: USPT Jun 27, 1972

US-PAT-NO: 3673465
DOCUMENT-IDENTIFIER: US 3673465 A

TITLE: STABILIZING MAGNETIC FIELDS

DATE-ISSUED: June 27, 1972

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Tschopp; Werner	Forch	N/A	N/A	CH

US-CL-CURRENT: 361/146

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw Desc | Image

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Term	Documents
HELMHOLTZ.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	3437
HELMHOLTZES	0
(11 AND HELMHOLTZ).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	3

Display 50 Documents, starting with Document: 3

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L12: Entry 3 of 3 File: USPT Jun 27, 1972

DOCUMENT-IDENTIFIER: US 3673465 A
TITLE: STABILIZING MAGNETIC FIELDS

ABPL:
A method and apparatus for automatically stabilizing the magnetic field produced by a coil, the stabilization being effected by connecting between the ends of the coil an electronic device which provides a negative resistance which is equal in magnitude to the resistance of the path over which current flows through the coil, so that the resistance between the coil ends is essentially zero and flux disturbances are automatically compensated by the counterflux induced in the coil by such disturbances.

BSPR:
In the apparatus of the present invention the excitation coils themselves take over the function of detection as well as of correction of field or flux fluctuations so that further detection and/or correction coils become unnecessary. The described self-contained correction system may be combined with other stabilization methods such as, for example, stabilization by means of nuclear magnetic resonance.

DEPR:
A second embodiment is shown in FIG. 5. Here, for example, the field of a pair of Helmholtz coils 1, 1 is to be stabilized.

DEPR:
An essential characteristic of Helmholtz coils is that the currents through the two coils be identical. This can be achieved by connecting them in series or by connecting them in parallel, as shown, and providing suitable, well-known means for regulating the currents through them. The electronic means 2 of the present invention are disposed between the ends of the parallel-connected coils 1, 1. To feed the coils, a current is produced in a current supply source 3 and applied to the coils. This current can also be used to modulate the intensity of the magnetic field, for example, to give it a sinusoidal or sawtooth time variation, if the current supply source is provided with suitable current modulators.

DEPR:
One embodiment for such a combination of stabilization techniques is shown in FIG. 9. The coils 1 feed an electromagnet having a core and pole pieces 4. Feeding by device 3 and stabilization by means 2 occur as described above. In the field between the pole pieces there is a nuclear magnetic resonance measuring head 8 whose output leads to a measuring device with a transmitter 9. In this measuring device a disturbance signal is produced which originates from a deviation in the transmitting frequency of the nuclear resonance head 8 from the resonant frequency of the employed material in the given magnetic

field. This disturbance signal is fed to the coils 1 in the form of a disturbance current and thus effects a correction of the field. The embodiment is distinguished by the fact that a disturbance current signal which originates from another stabilization device, mainly from a nuclear resonance field stabilization device, is fed into the short-circuit connection of the coil.

CLPR:
9. An arrangement as defined in claim 8 wherein said additional field stabilizing device operates according to the principle of the nuclear magnetic resonance.

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Search Results - Record(s) 1 through 1 of 1 returned.

☐ 1. Document ID: US 6214019 B1

L14: Entry 1 of 1 File: USPT Apr 10, 2001

US-PAT-NO: 6214019
DOCUMENT-IDENTIFIER: US 6214019 B1

TITLE: Convergent magnetic stereotaxis system for guidance to a target

DATE-ISSUED: April 10, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Manwaring; Kim H.	Provo	UT	N/A	N/A
Manwaring; Mark L.	Pullman	WA	N/A	N/A

US-CL-CURRENT: 606/130

Full | Title | CIT.1 | REV.1 | CLS.1 | REF.1 | DRAW.1

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Term	Documents
ELLIPSE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	25832
ELLIPSES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4621
ELLIPTICAL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	66826
ELLIPTICALS	0
ELLIPTICALLY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	8138
ELLIPTICALLIES	0
ELLIPTICALLYS	0
(11 AND (ELLIPTICALLY OR ELLIPSE OR ELLIPTICAL)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	1

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Search Results - Record(s) 1 through 3 of 3 returned.

☐ 1. Document ID: US 5659281 A

L18: Entry 1 of 3 File: USPT Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 2. Document ID: US 5543770 A

L18: Entry 2 of 3 File: USPT Aug 6, 1996

US-PAT-NO: 5543770
DOCUMENT-IDENTIFIER: US 5543770 A

TITLE: Apparatus for generating uniform and parallel magnetic field, the intensity of which is variable

DATE-ISSUED: August 6, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Sasaki; Tsutomu	Kawasaki	N/A	N/A	JPX
Itoh; Ikuo	Kawasaki	N/A	N/A	JPX

US-CL-CURRENT: 335/299; 335/216, 336/DIG.1, 505/211, 505/879

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 3. Document ID: US 4236964 A

L18: Entry 3 of 3 File: USPT Dec 2, 1980

- US-PAT-NO: 4236964
  DOCUMENT-IDENTIFIER: US 4236964 A

  TITLE: Confinement of high temperature plasmas

  DATE-ISSUED: December 2, 1980

  INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

  US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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Term	Documents
ELLIPSE.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	25832
ELLIPSES.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	4621
ELLIPTICAL.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	66826
ELLIPTICALS	0
ELLIPTICALLY.DWPI,TDBD,EPAB,JPAB,USPT,PGPB.	8138
ELLIPTICALLIES	0
ELLIPTICALLYS	0
(17 AND (ELLIPTICALLY OR ELLIPSE OR ELLIPTICAL)).USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	3

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Display Format: [CIT] Change Format

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Search Results - Record(s) 1 through 14 of 14 returned.

☐ 1. Document ID: US 6278276 B1

L19: Entry 1 of 14 File: USPT Aug 21, 2001

US-PAT-NO: 6278276
DOCUMENT-IDENTIFIER: US 6278276 B1

TITLE: Phased array gradient coil set with an off center gradient field sweet spot

DATE-ISSUED: August 21, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Morich; Michael A.	Mentor	OH	N/A	N/A
Retropoulos; Labros S.	Solon	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

---

☐ 2. Document ID: US 6278275 B1

L19: Entry 2 of 14 File: USPT Aug 21, 2001

US-PAT-NO: 6278275
DOCUMENT-IDENTIFIER: US 6278275 B1

TITLE: Gradient coil set with non-zero first gradient field vector derivative

DATE-ISSUED: August 21, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Petropoulos; Labros S.	Solon	OH	N/A	N/A
Schlitt; Heidi A.	Chesterland	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/309, 324/320

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

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☐ 3. Document ID: US 6214019 B1

L19: Entry 3 of 14 File: USPT Apr 10, 2001

US-PAT-NO: 6214019
DOCUMENT-IDENTIFIER: US 6214019 B1

TITLE: Convergent magnetic stereotaxis system for guidance to a target

DATE-ISSUED: April 10, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Manwaring; Kim H.	Provo	UT	N/A	N/A
Manwaring; Mark L.	Pullman	WA	N/A	N/A

US-CL-CURRENT: 606/130

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 4. Document ID: US 6150816 A

L19: Entry 4 of 14   File: USPT   Nov 21, 2000

US-PAT-NO: 6150816
DOCUMENT-IDENTIFIER: US 6150816 A

TITLE: Radio-frequency coil array for resonance analysis

DATE-ISSUED: November 21, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Srinivasan; Ravi	Richmond Heights	OH	N/A	N/A

US-CL-CURRENT: 324/318; 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 5. Document ID: US 6060882 A

L19: Entry 5 of 14   File: USPT   May 9, 2000

US-PAT-NO: 6060882
DOCUMENT-IDENTIFIER: US 6060882 A

TITLE: Low-inductance transverse litz foil coils

DATE-ISSUED: May 9, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doty; F. David	Columbia	SC	N/A	N/A

US-CL-CURRENT: 324/318; 324/319, 324/322, 600/421

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 6. Document ID: US 5798679 A

L19: Entry 6 of 14   File: USPT   Aug 25, 1998

US-PAT-NO: 5798679
DOCUMENT-IDENTIFIER: US 5798679 A

TITLE: Magnetic flux bending devices

DATE-ISSUED: August 25, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A

US-CL-CURRENT: 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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7. Document ID: US 5659281 A

L19: Entry 7 of 14   File: USPT   Aug 19, 1997

US-PAT-NO: 5659281
DOCUMENT-IDENTIFIER: US 5659281 A

TITLE: Structured coil electromagnets for magnetic resonance imaging

DATE-ISSUED: August 19, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pissanetzky; Sergio	The Woodlands	TX	N/A	N/A
McIntyre; Peter M.	College Station	TX	N/A	N/A

US-CL-CURRENT: 335/296; 324/318, 335/216, 335/299

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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8. Document ID: US 5633588 A

L19: Entry 8 of 14   File: USPT   May 27, 1997

US-PAT-NO: 5633588
DOCUMENT-IDENTIFIER: US 5633588 A

TITLE: Superconducting magnet apparatus using superconducting multilayer composite member, method of magnetizing the same and magnetic resonance imaging system employing the same

DATE-ISSUED: May 27, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hommei; Takao	Hitachinaka	N/A	N/A	JPX
Takuma; Yutaka	Tokyo	N/A	N/A	JPX
Takeshima; Hirotaka	Ryugasaki	N/A	N/A	JPX
Takeuchi; Hiroyuki	Kashiwa	N/A	N/A	JPX
Miyamoto; Yoshiyuki	Abiko	N/A	N/A	JPX
Fukutomi; Kiyoshi	Tokyo	N/A	N/A	JPX
Kawano; Hajime	Abiko	N/A	N/A	JPX

US-CL-CURRENT: 324/320; 324/319

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

9. Document ID: US 5543770 A

L19: Entry 9 of 14 File: USPT Aug 6, 1996

US-PAT-NO: 5543770
DOCUMENT-IDENTIFIER: US 5543770 A

TITLE: Apparatus for generating uniform and parallel magnetic field, the intensity of which is variable

DATE-ISSUED: August 6, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Sasaki; Tsutomu	Kawasaki	N/A	N/A	JPX
Itoh; Ikuo	Kawasaki	N/A	N/A	JPX

US-CL-CURRENT: 335/299; 335/216, 336/DIG.1, 505/211, 505/879

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

10. Document ID: US 5196796 A

L19: Entry 10 of 14 File: USPT Mar 23, 1993

US-PAT-NO: 5196796
DOCUMENT-IDENTIFIER: US 5196796 A

TITLE: Anatomically conformal quadrature MRI surface coil

DATE-ISSUED: March 23, 1993

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Misic; George J.	Novelty	OH	N/A	N/A
Reid; Eric D.	Turtle Creek	PA	N/A	N/A

US-CL-CURRENT: 324/322

Full | Title | Citation | Front | Review | Classification | Date | Reference | KWIC | Draw Desc | Image

11. Document ID: US 4899108 A

L19: Entry 11 of 14 File: USPT Feb 6, 1990

US-PAT-NO: 4899108
DOCUMENT-IDENTIFIER: US 4899108 A

TITLE: High frequency coil

DATE-ISSUED: February 6, 1990

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Fujita; Michiru	Kawasaki	N/A	N/A	JPX
Higuchi; Masao	Kawasaki	N/A	N/A	JPX

US-CL-CURRENT: 324/318

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 12. Document ID: US 4890082 A

L19: Entry 12 of 14   File: USPT   Dec 26, 1989

US-PAT-NO: 4890082
DOCUMENT-IDENTIFIER: US 4890082 A

TITLE: Coil for generating a homogeneous magnetic field

DATE-ISSUED: December 26, 1989

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Fujita; Michiru	Kawasaki	N/A	N/A	JPX

US-CL-CURRENT: 335/301; 324/320, 335/216

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

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☐ 13. Document ID: US 4236964 A

L19: Entry 13 of 14   File: USPT   Dec 2, 1980

US-PAT-NO: 4236964
DOCUMENT-IDENTIFIER: US 4236964 A

TITLE: Confinement of high temperature plasmas

DATE-ISSUED: December 2, 1980

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Bass; Robert W.	Provo	UT	N/A	N/A
Ferguson; Helaman R. P.	Orem	UT	N/A	N/A
Fletcher; Harvey J.	Coltsneck	NJ	N/A	N/A
Gardner; John H.	Provo	UT	N/A	N/A
Harrison; B. Kent	Provo	UT	N/A	N/A
Larsen; Kenneth M.	Provo	UT	N/A	N/A

US-CL-CURRENT: 376/133; 376/137, 976/DIG.1

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Image

14. Document ID: DE 3828407 A, DE 3828407 C2, GB 2208937 A, GB 2208937 B, JP 01170449 A, US 4899108 A

L19: Entry 14 of 14 File: DWPI Mar 2, 1989

DERWENT-ACC-NO: 1989-069810
DERWENT-WEEK: 198910

TITLE: HF coil for atomic nuclei resonance in computer tomography - has number of unit coils containing line sections and having common centre point

INVENTOR: FUJITA, M; HIGUCHI, M

PRIORITY-DATA: 1987JP-0329133 (December 25, 1987), 1987JP-0207635 (August 21, 1987), 1987JP-0207636 (August 21, 1987)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
DE 3828407 A	March 2, 1989	N/A	021	N/A
DE 3828407 C2	February 16, 1995	N/A	020	G01R033/34
GB 2208937 A	April 19, 1989	N/A	000	N/A
GB 2208937 B	April 1, 1992	N/A	000	N/A
JP 01170449 A	July 5, 1989	N/A	000	N/A
US 4899108 A	February 6, 1990	N/A	018	N/A

INT-CL (IPC): A61B 10/00; G01N 24/04; G01R 33/22; G01R 33/34; H01F 5/02; H01F 7/20

Full | Title | Citation | Front | Review | Classification | Date | Reference   KWIC | Draw Desc | Clip Img | Image

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L19: Entry 3 of 14 File: USPT Apr 10, 2001

DOCUMENT-IDENTIFIER: US 6214019 B1
TITLE: Convergent magnetic stereotaxis system for guidance to a target

ABPL:
A guidance system for guiding a surgical instrument without visual information to a target in tissue. The system centers the target upon the trajectory of an infinite family of zero-flux curvilinear lines emanating from either a fixed magnet or an ac or dc electromagnet which is mounted on the instrument. The approach to the target allows selection of straight and curved trajectories based on the zero-flux lines that intersect the target. A self-centering attachment that holds the magnet allows any straight instrument to be guided by the system. The zero-flux lines are measured by a magnetometer that is located on a remote location on or in the tissue. The transducers of the magnetometer measure the magnetic field strength that is present if the instrument deviates from the zero-flux line. The guidance information is plotted on a display that allows a user to guide the instrument along the zero-flux line to the target. An alternative embodiment uses a sensing magnetometer in the instrument tip that measures the field strength that is generated from a magnet that is placed on a remote location on or in the tissue.

BSPR:
The invention relates to a method and apparatus for directing a surgical instrument to a target location. More specifically, the invention relates to using a magnet and a magnetometer to guide the instrument on zero-flux lines to the target location.

BSPR:
To minimize the risk of malposition, a surgeon has several options. For example, well-described, externally palpable landmarks of the cranium may be used to select and drill a hole. The catheter is then aimed toward another palpable landmark of the head, expecting to intersect an optimal target location at a depth judged from review of imaging studies such as computed tomography (CT) and magnetic resonance imaging (MRI). However, this technique is difficult to employ due to human variation in landmarks, variability in the ventricle size and position, and encumbrance of surgical drapes used to isolate a surgical field. Malposition attributable to these variables is a common complication.

BSPR:
Intraoperative CT and MRI (so-called open MRI) allow precise guidance, but the necessary equipment for these procedures present significant hindrances to sterile setup, timely operation, operating room efficiency, and cost since such equipment is not ordinarily used in the operating room. These techniques also operate by emitting ionizing energy which may have cumulative potential injurious effect in the case of CT or interfering magnetic fields in the case of MRI.

BSPR:
Thus, there exists a need for a catheter positioning device which: a) is simple, requiring minimal setup time, expense, training or expertise of the surgeon; b) allows precise guidance during surgery despite encumbrance of surgical drapes and difficulty at palpation of common landmarks; c) allows optimal target selection based on pre-operative imaging studies such as CT and MRI of the head; d) avoids invasiveness of a frame application to the patient or special imaging procedures to allow such guidance; and e) builds on the existing standards for the surgical approach to the ventricle system.

BSPR:
The above needs and problems are solved by the present invention, which is embodied in a guidance system for use in conjunction with an instrument having a substantially straight portion and a tip. The system determines the path of the instrument to a target area within tissue. The system has a magnet which is mounted on the substantially straight portion of the instrument and which emits a magnetic field with a family of zero-flux lines perpendicular to isogaussian planes. The target area is intersected by a selected zero-flux line. A self-centering housing may be coupled

to the substantially straight portion of the surgical instrument and holds the magnet such that the magnetic center is aligned with the instrument. A magnetometer is placed in or on a remote tissue site in approximate alignment with the target area. The magnetometer includes an x-plane transducer, a y-plane transducer and a z-plane transducer. A guidance circuit is coupled to the transducer array and indicates when the magnet deviates from the selected zero-flux line.

BSPR:
The invention is also embodied in a guidance system for use in conjunction with a surgical instrument having a tip which is inserted in tissue. The system determines the arrival of the tip of the surgical instrument at a target area within the tissue. The system has a magnetometer in the instrument tip. The magnetometer includes an x-plane transducer, a y-plane transducer and a z-plane transducer. A magnet which emits a magnetic field with a family of zero-flux lines perpendicular to isogaussian planes is provided. The target area is intersected by a selected zero-flux line. The magnet is located on a remote tissue site in approximate alignment with the target area. A guidance circuit is coupled to the transducer array which indicates when the magnet deviates from the selected zero-flux line.

DRPR:
FIG. 5 is a chart of flux lines and perpendicular "zero-flux" trajectories of a magnet used by the present invention.

DRPR:
FIG. 6 is an axial MRI scan showing the orientation of flux lines and placement of the magnetometer for application of the present invention.

DRPR:
FIG. 7 is a coronal MRI scan of the brain showing a family of "zero-flux lines" and an alternate placement of the magnetometer for application of the present invention.

DRPR:
FIG. 10 is an axial MRI scan of a brain showing a target area, a family of "zero-flux lines" converging toward the target area and a magnetometer using the alternative embodiment of the present invention.

DRPR:
FIG. 11 is a sagittal MRI scan of a brain showing the target area, "zero-flux lines," and magnetometer of FIG. 10.

DEPR:
The instrument 12 is inserted in the burr hole 18 on the cranium 16. Once the surgeon elects a fixed entry site such as the burr hole 18, this becomes a pivot point to guide the instrument 12 along a defined zero-flux line from the magnet 30 measured by the magnetometer 34 to the target area 14 as will be explained below. The magnetometer 34 is coupled to a data interface device 44 via a data input 46. The data interface 44 in this example is a 21X Datalogger manufactured by Campbell Scientific, Incorporated of Logan, Utah. However, any data interface that is capable of real time earth magnetic field measurement and subtraction from the emitted magnetic field of a magnet may be used. The data interface 44 may be eliminated if a digital magnetometer with signal processing capability is used such as the HMR2300 digital magnetometer manufactured by Honeywell. The data taken from the magnetometer 34 is output via a data output port 48.

DEPR:
Alternatively, a bar magnet may be used instead of a horseshoe magnet. Such a bar magnet would be mounted perpendicularly to the shaft 26 to place the poles in a similar position as those of a horseshoe magnet. Alternatively, the magnet 30 may be an electromagnet. The electromagnet is energized by either a DC current, a pulsed DC current or an AC current. While common ceramic magnets can be employed for the magnet 30, much stronger magnets such as alnico or rare earth magnets are preferable to optimize measurement of a zero-flux line by the magnometer 34. Similarly, an alternating field could be obtained by rotating the magnet within the housing using a small rotary motion source such as a wind-up motor or electric motor.

DEPR:
The screen 60 includes a pair of glidepath cross hairs 62 and 64. Glidepath cross hair 62 is the x (left-right instrument tip position) axis and glidepath cross hair 64 is the y (up-down instrument tip position) axis. The glidepath cross hairs 62 and 64 are centered on the screen 60, indicating the surgeon's ideal glidepath down a zero-flux line to the target 14. The deviation of the tip 24 of the instrument 12 off of the glidepath is indicated by tip location cross hairs 66 and 68 which are the x and y axes respectively. A magnet plane is plotted as a compass heading line 70 extending out of the guideline cross hairs 62 and 64. Using the tip location cross

hairs 66 and 68, a surgeon "pulls" the tip 24 of the instrument 12 back physically to align the tip with the glidepath cross hairs 62 and 64 much as a skeet shooter sites his gun and pulls the barrel back on target.

DEPR:
The operation of the system 10 according to the present invention will now be explained with reference to FIGS. 1-4 and FIG. 5 which shows a pattern of flux lines 100 which emanate from the magnetic center of a bar magnet 102 as concentric ellipses approximating circles. The flux lines 100 represent isogaussian planes of field density, diminishing in strength with distance from the center of the magnet 102. A simple, fixed magnet (or an electromagnet) emits a magnetic field with a shape that is influenced by the magnet's geometry and the alignment orientation of its magnetic domains. This pattern depicts the approximate shape of isogaussian distributional, though the exact shape is normally slightly more shortened in the perpendicular plane away from the magnet 102. The depiction in FIG. 5 also approximates a pattern for a horseshoe or U-shaped magnet such as the magnet 30 in FIG. 1.

DEPR:
The pattern of a constant, pulsed, or continuously alternating magnetic flux distribution at a given point in time is thus represented in FIG. 5. The strength of a magnetic field emanating from a magnet 102 will be constant on any flux line 100 as measured by the magnetometer 34 in FIG. 1 if the magnetometer transducers 38, 40 or 42 are oriented tangentially to the elliptical line.

DEPR:
A perpendicular line extending from the center of the magnet and intersecting the flux lines 100 at right angles to the elliptical or near circular flux line defines a "zero-flux line" 104. The strength of a magnetic field emanating from the magnet 102 will always be zero on a zero-flux line 104 as measured by the magnetometer 34 if the z-plane transducer 42 remains oriented perpendicular to the line 104. Misalignment to the zero-flux line 104 will result in a measurable positive or negative magnetic field strength in the z-plane transducer 42. The deviation in field strength is displayed on the screen 60 to indicate direction and magnitude of required correction to re-align directly on the zero-flux line 104, which represents the glidepath to the target. The z-plane transducer 42 in the magnetometer 34 is aligned perpendicularly to a given zero-flux line such as flux line 104. The x- and y-plane transducers 38 and 40 will measure full intensity of the magnetic flux from the magnet 102 depending on the rotation of the magnet 102. As the instrument 12 is advanced down a zero-flux line such as flux line 104, it will eventually intersect the magnetic center of the magnet 102, thus providing an exact path to the magnetometer 34. If a target in the tissue is aligned with the magnetometer, it may be exactly intersected.

DEPR:
The magnet 30 in FIG. 1-3 will emit a symmetrical field in an x axis when oriented horizontally very similar to the field depiction in FIG. 5 due to its position. The y axis orientation is obtained by rotating the magnet 30 along with the housing 32 by 90 degrees to the vertical position. This allows feedback measurement of the maximum and minimum flux density by the x- and y-plane transducers 38 and 40 of the magnetometer 34 for orientation in the y plane as seen in compass line 70. The rotation of the magnet 30 must be performed periodically to assure passage on a zero flux lines in both the x and y planes. The orientation change may be automated by use of a mechanically rotated magnet or by pulsing of housed electromagnets with sine waves 90 degrees out of position with each other.

DEPR:
The tip location cross hair 68 is derived in the x plane and generated on the screen 60 by measuring the magnetic field deviation away from the zero-flux line (or value of zero) using the z-plane transducer 42 of the magnetometer 34. The measured deviation is plotted either left or right of the guidance cross hair 64 by amplitude on the x plane. The point is plotted when the x-plane transducer 38 reads a maximum flux density and the y-plane transducer 40 reads a minimal flux density simultaneously.

DEPR:
Conversely, the tip location cross hair 66 is generated by measuring the deviation off of the glidepath in the y plane. The deviation away from the zero-flux line (or value of zero) on the z-plane transducer 42 of the magnetometer 34 is measured. This value is plotted above or below the guideline cross hair 62 by amplitude on the y plane. The point is plotted when the y-plane transducer 40 reads a maximum flux density and the x-plane transducer 38 reads a minimal flux density simultaneously.

DEPR:
Better accuracy for traversal of a zero-flux line is gained by using a straight instrument such as an endoscope with the shortest possible length between the tip and

the housing 32. This is due to the perpendicularity of the zero-flux line at intersection with the tangent of the near circular ellipses. In practice, this is a minor limitation as accuracy improves as the instrument approaches the target due to convergence of zero-flux lines toward the magnetometer.

DEPR:
In order to guide the instrument tip 24 along a zero-flux line as detected by the magnetometer 34, it is necessary to cancel out the earth's magnetic field effect and to eliminate, control for, or subtract out sources of magnetic interference in the surgical environment. Since the technique of converging accuracy as described above embodies the element of increasing magnetic field strength as the target 14 is approached, minimal interference is encountered in the normal surgical environment. This is due to conventional use of non-magnetic stainless steel instruments and sufficient distance from substantial ferromagnetic material, such as iron and steel in operating tables and microscope bases. It is only necessary in normal practice to zero the magnetometer with the instrument and housing containing the magnet at least 1 meter removed from the surgical field. Current surgical practice demonstrates convergence on the magnetometer as a target to within 1 mm when this guideline is employed.

DEPR:
Yet another approach yields similar accuracy based on convergence of zero-flux lines as the target is approached. The entry burr hole site 18 is touched by the instrument 12 and housing 32 containing the magnet 30 in correct orientation. The instrument 12 is aimed by visual alignment technique to the target 14, estimating its internal location. The magnetometer 34 is then zeroed by subtracting existing flux values out to a value of zero. As the instrument 12 is further advanced into the cranium 16, deviation off of a zero flux line to the magnetometer 34 as a target is easily recognized and guidance is performed identically as above, obtaining similar accuracy.

DEPR:
Typically, an approach to the target 14 is selected using imaging studies. In this example, the surgeon has elected a posterior cranial approach to the target 14. FIG. 6 is an axial MRI scan of the cranium 16 showing the target 14 and selected zero-flux lines leading toward the target 14 and the magnetometer 34. As the magnetic field permeates the cranium 16 and soft tissues of scalp and brain without impediment, a zero-flux trajectory line 108 to the target is detectable within and outside the cranium 16. The magnetometer 34 is placed on the midline forehead area 20 due to size and external electrical connections. The magnetometer 34 is on the selected zero-flux line 108 downpath from the target 14 and the magnet 30 and its magnetic field.

DEPR:
If the surgeon encounters an impediment in the path, such as an overlying vital vessel, he can move to an adjacent or removed site, so long as a zero-flux line intersects this region, which will also guide him to the target. A distinct advantage of this invention is the wide latitude of options presented to the surgeon requiring only geographic approximation of an entry site to allow convergence on the target as illustrated in FIG. 6. Further, a curved path may be elected if it offers advantages compared to a relatively straight path. The emitted magnetic field zero-flux line 108 as detected by the magnetometer 34 is a curved trajectory line converging on the target 14 as illustrated in FIG. 6. In addition, multiple consecutive or simultaneous paths to the same target may be employed for multiple instruments without additional planning.

DEPR:
An example of an alternative approach to an intracranial target is shown in FIG. 7, which is an MRI scan of a typical coronal cut of the brain. This approach employs the same elements as the system 10 in FIGS. 1-4. The target 14 is in the identical location of a frontal horn of the lateral ventricles in the cranium 16 as the view in FIG. 6. The magnetometer 34 is placed in the anesthetized patient's mouth against the soft palate and dorsal to the typical location of an endotracheal tube. The surgeon can elect a family of zero-flux lines 110 that will offer a trajectory within the confines of the target space to its intersection. The depth from a coronal burr hole on the top of the head to the target may be measured by conventional, readily available techniques in the radiologic suite from CT or MRI type images.

DEPR:
Depth to the target 14 may also be indicated by measuring increasing field strength in the two x and y-plane transducers 38 and 40 in the magnetometer 34. The third z-plane transducer 42 in the magnetometer 34 measures flux in the direction toward the instrument passage and indicates deviation off of the zero-flux "glidepath." Therefore, the magnetometer 34 provides corrective information to re-align the instrument 12 to the glidepath to the target 14.

DEPR:
This orientation of the magnet 150 results in a zero-flux line pattern as shown in FIG. 8. In this embodiment, the x-plane and y-plane transducers 38 and 40 of the magnetometer 34 measure the deviation of the microscope 152 and the magnet 150 from a position parallel to the flux lines emulating from the magnet 150. The orientation of the magnet 150 results in detecting a zero-flux line when the x- and y-plane transducers 38 and 40 in the magnetometer 34 read zero field strength because they are perpendicular to the flux line. Conversely, the z-plane transducer 42 will measure full strength of the flux line as it is parallel and coincident to it. The proximity of the magnet 150 to the magnetometer 34 to the target 14 in the cranium 16 is thus derived from the increasing strength of the magnetic field as measured by the z-plane transducer 42.

DEPR:
This variation has the advantage that it is unnecessary to rotate the magnet 150 in order to obtain the x- and y-plane zero-flux line position of the tip of the instrument 12. A microscope 152 may be aligned to the target 14. The microscope may be placed to determine the exact point of entry to reach the target 14. The alignment of the magnet 150 results in severe curvature of trajectories to a target when the instrument 12 is at some distance laterally removed from the magnetometer 34.

DEPR:
The guidance system 200 allows exact accuracy on the zero-flux line since the miniaturized magnetometer 224 is housed in the tip 214 of the instrument 202. Additionally, this embodiment allows either a straight or curved instrument to be used since the magnetometer 224 is located directly at the tip 214 and thus it is unnecessary to compensate for the distance between it and the tip. The alternative embodiment may be used with flexible tip instruments such as a steerable fiberscope. The location of the magnet 220 outside of the patient allows the magnet and hence the magnetic field to be stronger and thus more measurable.

DEPR:
FIGS. 10 and 11 show typical views of an MRI scan of the brain in axial and sagittal orientations respectively in conjunction with the guidance system 200. In FIGS. 10 and 11 the target 204 is in the frontal horn of a lateral ventricle of the cranium 206. Flux lines emanating from the magnet 220 and zero-flux lines 256 have been superimposed to illustrate a family of convergent paths that may be selected for an appropriate burr hole to guide the instrument 12 forward toward the magnet 220. On inspection, a converged set of lines intersecting the target in the frontal horn may be readily identified. Posteriorly there is a wide selection of potential entry sites that follow a zero-flux line toward the target up-field from the magnet.

DEPR:
The scans in FIGS. 10 and 11 demonstrate convergence toward the target when the magnet 220 has been placed on the forehead. This is shown for illustrative purposes only as the magnet 220 may be placed in any convenient site in or on the tissue in approximate alignment with the target 204. A family of zero-flux lines 256 indicating a wide range of potential cranial entry sites converge upon and within the borders of the target area.

DEPR:
The instrument 202 and attached magnetometer 224 may be advanced along any of the zero-flux lines 256 as measured by the magnetometer 224. The measured flux lines are used for a visual display similar to FIG. 4 to guide the instrument 202 along a suitable glidepath.

CLPR:
8. The guidance system of claim 1 wherein the guidance circuit further comprises a distance circuit to determine the distance to the target area by measuring field strength emitted by the magnet perpendicular to the zero-flux line by the magnetometer.

CLPR:
16. The guidance system of claim 1 further comprising a compensation circuit which zeroes the magnetometer for static effects of earth's field and any ferromagnetic or electromagnetic dc effects by subtracting the flux offsets in x, y, and z plane transducers of the magnetometer to zero.

CLPR:
21. The method as claim 20 further comprising the step of zeroing the magnetometer for static effects of the earth's field and ferromagnetic or electromagnetic dc effects by placing the instrument with the attached magnet at a distance from the entry site and subtracting flux offsets in x-, y-, and z-plane transducers of the

magnetometer to zero.

CLPR:
22. The method of claim 20 further comprising the step of overlaying imaging scans of the body with a pattern of isogaussian flux planes in the axial, sagittal, or coronal planes to define a family of zero-flux lines converging on the affixed magnetometer.

CLPR:
24. The method of claim 23 wherein the step of inserting the instrument further comprises selecting an intersecting zero-flux line extending from the entry site and converging on the magnetometer and the target area.

CLPR:
26. The method of claim 25 further comprising the step of displaying a 3-dimensional display of the depth of passage along the zero-flux trajectory line to the target area.

CLPV:
a magnet emitting a magnetic field with a family of zero-flux lines perpendicular to isogaussian planes, wherein a selected zero-flux line is intersectable with the target area and serves as a path for the instrument and the magnet is mountable on the straight portion of the instrument;

CLPV:
a magnetometer capable placed in or on a remote site in approximate alignment with the target area and the selected zero-flux line, the magnetometer including a transducer array having a x-plane transducer, a y-plane transducer and a z-plane transducer; and

CLPV:
a guidance circuit coupled to the transducer array which indicates when the magnet deviates from the selected zero-flux line.

CLPV:
a magnet emitting a magnetic field with a family of zero-flux lines perpendicular to isogaussian planes, wherein the magnet has a magnetic center and a selected zero-flux line is intersectable with the target area and the magnet is mountable on the straight portion of the instrument;

CLPV:
a guidance circuit coupled to the transducer array which indicates when the magnet deviates from the selected zero-flux line;

CLPV:
selecting a path to the target area by selecting a zero-flux line from the magnetic field which intersects the target area;

CLPV:
zeroing the magnetometer for static effects of the earth's field and ferromagnetic or electromagnetic dc effects by placing the instrument with the attached magnet at the fixed entry site in approximate visual orientation toward the target area and magnetometer and subtracting flux offsets in x-, y-, and z-plane transducers of the magnetometer to zero.

CLPV:
providing a feedback display to enable correction of the position of the instrument to overlie the selected zero-flux trajectory line.